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JEFFERSON DAVIS GRIFFITH, M.D.

In the death of Dr. Jefferson Davis Griffith, on August 29, 1924, the medical profession has lost an estemeed physician who has linked the older practice of the proprietary school educational days with that of modern scientific precision. Temperamentally a progressive, he was guided in the path of progress by common sense and natural good judgment, enhanced by a shrewd power of observation exercised in many years of general practice and surgery. A practical turn of mind prompted him to work in a field where definite beneficial results were possible and manifest. He became earnestly interested in orthopaedic surgery at an early stage of the development of the organized movement which, by the excellence and originality of its achievements and the energy of its organization, placed this specialty in prominence in this country,—the American Orthopedic Association.

Though not a voluminous writer, his contributions were always of value, and in the discussion of papers at the annual meetings of the Association his remarks were always important.

Named for the ideal of his native State, Mississippi, he ran away from home when his father, an officer in the Southern army, was killed, and he was with the army inside the lines of Vicksburg when it was beseiged and captured. He used to say "I wasn't so very big, but I could pull a lanyard as well as any man." He was then only fourteen years old. It was the

stuff in such a boy that made the man, and that man alone who met unflinchingly and with courage the many conditions which rose in his early life. No one can say that Dr. Griffith ever turned his back on a difficult or dangerous problem.

He was a great surgeon in the war with Spain, and surgeon general of Missouri for years. When St. Joseph's Hospital was opened in Kansas City he performed the first operation, and when the new hospital was opened, thirty-eight years after the first, he performed the first operation there, too,—a remarkable career,—the leading surgeon of a city for nearly half a century.

What one loves best one does best, and what Dr. Griffith loved best was to have friends that loved him. He made them by the hundred and liked to have them with him and entertain them. He used to say "Mr. Lincum and I were born on the same day, and don't you forget that you are to come on the 12th of February. The latch-string is always out." And when his friends came they found that all had been prepared.

Of the greatest value to the community and to his friends, as well as his colleagues, was his attractive and friendly personality. This not only bore all the worth of the traditional good physician, but there was also added the spirit of good fellowship which strengthens friendship, making it among the richest blessings of life.

Dr. Griffith's memory needs no eulogy: it will always remain and be kept green through the recollection of his genial personality in the hearts of a multitude of friends of both the earlier and later days.

THE PROBLEM OF THE ORTHOPAEDIC LECTURE*

BY ROBERT B. OSGOOD, M.D., BOSTON, MASS.
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Since most of the members of the American Orthopedic Association and many of our guests are concerned with the teaching of orthopaedic surgery to undergraduates, it may be pertinent to discuss the problem of the orthopaedic lecture.

That the didactic lecture has in the past not proved to be an entirely satisfactory method of imparting medical knowledge is evidenced by the growing tendency in all progressive schools to shorten the number of hours assigned to lectures and to increase the number of hours devoted to clinical or bedside teaching. Let us try to state the advantages of the didactic lecture.

First, economy of instruction. The whole class is assembled and the fundamentals of the particular subject under consideration can be summarized by the lecturer in a way which the student may not be able to find in any textbook on orthopaedic surgery. Second, the personality of an efficient and thoughtful lecturer adds to the impressiveness of the subject, and his enthusiasm may well prove contagious, stimulating the student to wider reading and inducing him to familiarize himself with the practical details of the therapeutic measures advised. These two points in favor of the didactic lecture seem to us to comprise nearly all the advantages.

Considering now the disadvantages, we should place first what may be called lack of flexibility. The student in the ordinary didactic lecture is entirely at the mercy of the instructor who speaks, as it were, *ex cathedra*. If the student is to be able to pass the examination in the subject he must devote his entire attention during the lecture to the taking of notes, and this note-taking at a more or less furious rate must perforce distract his attention from the general scheme of the discourse and make it impossible for him often to distinguish between important and unimportant points. Any set of notes taken by the average student of a given lecture will demonstrate this real disadvantage. Secondly, the student has no

* Presented at the Annual Meeting of the American Orthopedic Association, May, 1924.

opportunity, either at the lecture or subsequently, to clarify any points which he does not understand at the time of the lecture. In the third place, he has no opportunity to visualize on clinical cases at the time of the lecture the points made by the lecturer as to the pathology of the lesions, the cardinal symptoms, or the treatment.

We think any instructor who cares to try the experiment of questioning the student some weeks after such a didactic lecture, without giving the student an opportunity to review his notes, will find that the average student has a very hazy idea as to the main points. In other words, little has been retained. To pass an examination the student must very carefully review his notes if he is to answer correctly questions which may be solely on the fundamentals of the subject considered. This experience we have personally had in questioning even very good students orally and unexpectedly on the subject matter of lectures given by one of the best lecturers we have ever known, who in his lectures stressed very carefully the fundamentals and sought by every means in his power to impress the students with these fundamentals. Having had this experience, we have tried during the last year a scheme which seems to have retained the advantages of the ordinary didactic lecture and overcome in the main its disadvantages. Moreover, in questioning the students in the same unexpected fashion some weeks after the lecture given on this new plan, the students have been found to have retained the essentials in a way which would suggest that this had become a part of their permanent knowledge.

That the lecture is still an orthopaedic problem is proved by the fact that in a survey of the teaching of orthopaedic surgery in a score of our best medical schools, didactic lectures are still found to occupy an important place. In all these schools such lectures are a part of the required course, varying in number from eleven to thirty-two. In most of the schools, in addition to the lectures, ward, dispensary or special clinical instruction in the specialty is given to small sections of the class throughout the year. In one important school, however, didactic lectures still supply the *only* required instruction in orthopaedic surgery. The teaching of the medical and surgical specialties remains a part of the required course in nearly all medical schools, but there is a growing tendency in most schools to allow the student in his last two years more time for outside reading and there are, therefore, fewer hours available for required lectures and section work.

Even if our aim is to teach the student in the required course in orthopaedic surgery only the fundamentals of the specialty, as Dr. Lovett has so wisely advised, we must, with these shortened hours, strive to

utilize the time at our disposal in the most economical and impressive manner. Only by so doing will the student be enabled to grasp these merest fundamentals. Clinical section work in ward or dispensary, or even in specially organized courses, is prodigal of time. Its value is unquestioned, but with the present allotment of hours we can hardly hope to convey even that minimum of basic knowledge which orthopaedic surgery has acquired and which unquestionably ought to be the possession of every general practitioner of medicine.

If we could devise some method of directional instruction in the fundamentals which could be imparted satisfactorily to the whole class in an hour assigned to a didactic lecture, we should be advancing in the direction of the economical use of the time at our disposal. Moreover, we should render the section work vastly more valuable, since with these fundamentals in his possession the student could more readily grasp the significance of the special cases which he examines.

With this purpose in view, the Department of Orthopaedic Surgery of the Harvard Medical School during the past year has changed its method of presenting the fundamentals of a given subject to the entire class of one hundred and twenty-five students in the hour assigned to a didactic lecture. No single feature of the scheme is new and if any originality exists it is only in the methods of combining these features.

The present curriculum calls for twelve lectures in orthopaedic surgery of one hour's duration, to be given to the entire third year class once a week, beginning with the school year. In addition each member of the class, in sections of eight students, receives clinical instruction for two and one-half hours on consecutive days for two weeks, totalling thirty hours. Thus forty-two hours are assigned to orthopaedic surgery in the third year.

The subjects to be considered in the twelve lectures have been chosen, not because of their prime importance in the practice of orthopaedic surgery as a specialty, but rather because of their important relationship to the practice of general medicine and general surgery. The lecturer has written out his lecture with as great care as possible in the most readable English of which he is capable, exactly as he would wish to deliver the lecture if he were to read or speak it. He has striven to stress the fundamentals of etiology and diagnosis, and to lay down only the broad general principles of a rational therapy. At the end of the lecture a few references to the most significant literature on the subject have been given. These lectures have been mimeographed and inclosed in folders. The first lecture was given to each man in the class about a week before the date set for

the delivery of the lecture. The students were asked to read the lecture and to take whatever notes they desired. They were instructed to bring to the lectures the mimeographed copy with their signature on the cover, and to exchange it for a lecture to be delivered on the week following.

The lecture hour has been divided into three twenty-minute periods. For the first twenty minutes the students are requested to ask the lecturer any questions germane to the subject under consideration, in order that they may amplify or clarify their conceptions. We viewed this experiment with a good deal of uncertainty as to its value. We feared the questions would lack significance and even doubted whether sufficient interest would be excited to provoke a large number of questions. We no longer consider it a doubtful experiment. The futile questions were negligible in number and the questions followed one another so rapidly that the time allotted to this period usually elapsed before the rapid fire ceased. It tested severely the lecturer's knowledge of his subject and brought out his personal method of approach to it. This part of the hour belonged to the students and they made good use of it.

The second twenty minutes, continued in conference form, were devoted to a demonstration of the points of diagnosis, pathology, symptomatology, and therapy which had been emphasized in the lecture. Illustrative clinical cases were shown, together with pathological specimens and lantern slides. This represented the visual attack.

During the third and last twenty minutes the lecturer quizzed the students from a class list in no alphabetic order. The answers were as a rule most intelligent and gratifying.

It will be seen that the plan presupposes first, a certain amount of interest in the subject by the students. In our experience this may be counted upon quite safely. Second, a willingness on the part of the lecturer to place himself during a part of the hour entirely at the disposal of the students. This reversal of the usual attitude has been greatly appreciated by the students. For the first year the plan entails an increased amount of labor on the part of the lecturer and necessitates a considerable expense to the department. After the first year both labor and expense are negligible. If during a year added knowledge in the fundamentals of a subject accrues, it may be supplied by one or more new stencils and additions to the mimeographed copy. The expense, even for the first year, could be eliminated if the students were permitted to purchase the mimeographed lectures, and new sets could be furnished each year. This the students are most eager to be allowed to do. Perhaps we shall adopt

this plan another year, but our reasons for requiring the students to hand back their copies are the following:

1. We do not wish the students to consider these fundamental lectures as even a brief textbook of orthopaedic surgery. Such a textbook would constantly fail them and the purpose of the lecturer would be misunderstood and quite rightly disparaged by other members of the profession. We wish rather to stimulate the student to outside reading in his search for more detailed knowledge.

2. If the student is *obliged* to read the lecture and to take what notes he desires in the quiet of his study before he attends the given lecture, he discovers his needs for amplification and explanation in time to have these needs supplied by the lecturer in answer to his questions.

3. He is much better prepared, if he has digested the lecture beforehand, to profit by that portion of the hour devoted to the demonstration of cases, pathological specimens, etc.

4. He is stimulated to so orderly construct and make his own the information placed before him as to be enabled to answer any questions which the instructor may ask him during the last part of the exercise.

The student has, therefore, presented to him three handles by which he is urged to grasp a subject. The first handle presents him with the opportunity of perusing an orderly, readable presentation of a subject and of taking his notes without hurry or confusion. The second enables him to amplify his knowledge and clear up doubtful points by questioning the lecturer. The third handle is the visual impression which is furnished by the demonstration of the main points in the lecture by means of lantern slides, pathological specimens, and clinical cases.

Some years ago Dr. Lovett abandoned the more or less haphazard ward visits and dispensary work in orthopaedic surgery which had heretofore represented the clinical instruction of the sections. He substituted a carefully organized series of clinical exercises under definite instructors who had no other duties for the time being than teaching. This organization has been continued with the help of card catalogues of illustrative and well disposed cases, the patients being sent for as the subject requires. These subjects are correlated with the lecture subjects with great care.

The results of this lecture system seem to us to justify its continuance. The students report to others than members of the Department of Orthopaedic Surgery that they like it and have had their interest in the subject stimulated. They have requested that some such system be extended to other departments, and one other special department has already adopted it for next year. A piece of evidence which is perhaps more convincing

is the students' apparent greater grasp of the subject when they are questioned orally at the end of their section work. The grade of answers to a rather searching examination given to those students who had completed their lecture and section work was surprisingly encouraging.

We begin to feel hopeful of at least presenting to the undergraduate an opportunity to learn some of the fundamentals of orthopaedic surgery in a lecture hour. We are also hopeful that some of these fundamentals will be acquired permanently and be found useful in the practice of medicine.

DISCUSSION ON PAPER OF DR. OSGOOD

Dr. E. W. Ryerson, Chicago: We all know from many years of familiarity with this work how much Dr. Osgood investigates and thinks about all the things that concern him as an orthopaedic surgeon. We have seen the evolution of orthopaedic surgery and we have seen its gradual approach to perfection, all done by hard investigative work. Not very often in the history of medicine and surgery has it occurred to any one to investigate scientifically the methods of teaching. Dr. Osgood has brought before us today what I think is by far the best method of investigation regarding teaching that I have ever heard of. It seems to me that one can find nothing in it about which to complain and that one can find in it everything to practice. When I was a student twenty-five or twenty-six years ago, it was not necessary to think so much about the student. In those days we were such brilliant students that we listened to lectures and we did not have to have any one think of the difficulties. We absorbed knowledge as a sponge absorbs water. The student today is different. He is a highly organized individual. He needs to have more recreation. I do not think nowadays one studies very much at night. I think if it is possible to crowd much into him during the day when you have control of him it should be done. I may be mistaken. Times may be just as they were when I was a student, but I think the young man has changed. I think this is a most ingenious way of teaching.

For years I taught by didactic lecture and by demonstrations in clinic. The results at the Cook County Hospital examinations where I read papers with Dr. Porter and others were simply awful. It is shocking how much intelligent teaching a young man can forget in the course of a few months. I thought the method should be changed; now I know I am right. I think any teacher who has a lack of confidence in his teaching ability should adopt Dr. Osgood's method. I think it should be printed and sent to all schools so that the teachers may adopt a uniform and satisfactory method of teaching.

Dr. Charlton Wallace, New York City: This is certainly a most admirable program that Dr. Osgood has for teaching students. If there is one weak point in it, it was thoroughly dwelt upon by one of the professors in discussing the possibility of calling out different students and handing the lectures to them as if they were high school boys. For a good many years, somewhere around ten, we have been following more or less the same scheme at Cornell, except that the student is assigned the subject and must cover that and recite upon it. Our method of teaching has reverted back to a compromise between the old-fashioned way of driving the student and leading him. Now we lead him into lectures. We have twelve or thirteen lectures, with demonstration on clinical patients, of one hour each. Then we have dispensary work, but the main

part of the teaching, where the student really learns, is where the student gets it for himself out of a book or out of anything that he wishes to study.

In the fourth year there are three hours a day three times a week for four weeks for each student. The work is carried on in this way: It is bedside and ward work at the Hospital for the Ruptured and Crippled. An instructor takes a group of three or four men through the ward and they study the case, going into the diagnosis, etiology, and treatment of that one patient. Each group of four of the ten men in that section is assigned one patient and there is a general discussion on that patient. Besides this clinical bedside work, the student is assigned a definite lesson on which he recites for one hour.

The question may well be asked, How do you know it works? We are rather fortunate at Cornell in having a faculty who are very anxious to give the student what he is paying for. We have organized there what is known as the "Phi Club." The members of each class select one from their number, freshman, sophomore, junior, and senior, to make a written report to this Phi Club. The membership also includes members of the faculty. These students criticise the instruction received during the year. Some very good constructive criticisms are made. I am not trying to assume all responsibility about the teaching of orthopaedic surgery at Cornell, but my associates have accomplished the purpose to such an extent that at the recent Phi Club meeting last Spring the fourth year men complained that they were getting only about fifty-nine or sixty-one hours in orthopaedic surgery, which they considered little enough. The part the students said they got the most out of was not the clinical lecture or the dispensary work, but the work upon which they were compelled to recite on a subject which had been assigned to them. I do not know a single school that gives sufficient time to orthopaedic surgery. It is a joke to try to teach it in less than twenty-five or thirty hours. There should be seventy-five or eighty hours devoted to orthopaedic surgery in every college, so as to give a little more than a skimming of the subject.

Dr. Arthur Steindler, Iowa City, Iowa: The teaching of orthopaedic surgery has given me just as much trouble and I have derived as many helpful hints from Dr. Osgood's talk as any one among us. Is it possible to devote seventy-five hours to orthopaedic surgery in the professional school? We are giving fifty-four hours for the seniors and twelve hours for the juniors at Iowa City, the juniors being divided into eight groups. I found it necessary to start with the orthopaedic principles, using twenty minutes out of the twelve lectures for the teaching of orthopaedic principles. I also use stereotype lessons, though I have not adopted the admirable method of Dr. Osgood of having them printed and read before the students. I think it is important to start with the principles of orthopaedic surgery. Some years ago Dr. Allison pointed out in a very admirable way what our relations ought to be to the general surgeon and I am very much in accord with him.

Dr. C. A. Stone, St. Louis, Mo.: At Washington University, St. Louis, we have stopped our didactic lectures. The men are getting their work with the patients. We find it does not pay to call the roll. We found the attendance increased until all the men in the sections were there. The classes are divided into thirds and we have one-third each time. We are giving all lectures and they are really not lectures. It is really work with the patient himself. We found this also: that the student is given the opportunit to ask questions about the patient at that time. We have found another thing: from having no students taking elective work in orthopaedic surgery, we have now

more men electing orthopaedic surgery than we have room for. I give this to you to consider for what it is worth.

Dr. Robert B. Osgood, Boston, Mass. (closing the discussion): I have nothing to add except to thank the Fellows for their generous reception of these very simple suggestions looking to a more efficient method of conducting the didactic lecture.

THE ETIOLOGY OF PSEUDOCOXALGIA; A CRITICAL SURVEY OF THE CONGENITAL THEORY

BY GEORGE PERKINS, LONDON.*
WITH A REPLY BY DR. MURK JANSEN, LEIDEN.

During the past few years, since the time when pseudocoxalgia became differentiated clinically from tuberculous arthritis of the hip joint, various etiologic theories have been propounded to account for the curious series of changes in the head and neck of the femur, as shown by radiograms. Of the more probable theories, three arrest attention: viz., the traumatic, the infective, and the congenital. Platt,[1] in 1922, reviewed the evidence and supported the infective theory. Since then the congenital theory has been brought into prominence by the advocacy of two surgeons, Calot and Jansen. M. Calot[2] maintains that the condition is due to a congenital subluxation of the hip joint, and states that some malformation of the hip joint is present in the radiogram of every case of pseudocoxalgia. Dr. Murk Jansen[3] is more specific. He describes exactly the malformation, suggests its cause, and explains why the changes of pseudocoxalgia result.

The intention of this paper is to survey critically the congenital theory, more particularly that postulated by Jansen.

JANSEN'S THEORY

Definition of the malformation. Dr. Murk Jansen attributes all the X-ray changes seen in pseudocoxalgia to the mechanical fact that the curve of the hip socket does not correspond with the curve of the femoral head—the socket curve is flatter than the curve of the femoral head. This flattening, he considers, is due to one of two causes: either the bony floor of the acetabulum is too thick, or the ischium is bent inward toward the midline, the centre of the hip socket being the centre around which the movement occurs—a condition which Jansen terms "ischium varum."

Jansen's diagrams, which are here reproduced, lucidly explain his meaning. Fig. 1 (a) shows a normal hip socket: the curve of the femoral head and the socket curve correspond. Fig. 1 (b) shows a thickened bony floor: the curve of the femoral head does not correspond with the socket curve; the latter is less curved, and the hip socket is too shallow. Fig. 1 (c) shows

* From the Orthopaedic Department, St. Thomas's Hospital, London.

an ischium varum. The ischium, instead of running directly downward as in (a) and (b), runs from above and out, downward and in.

Cause of the malformation. Jansen believes that the ischium varum and the thickened floor socket are congenital in origin, and are due to too small an amniotic sac. Either (1) the small amniotic sac tends to flex and

FIG. 1 (a)
Normal socket
The socket fits round the head. (Socket - line and outline of head run parallel.)

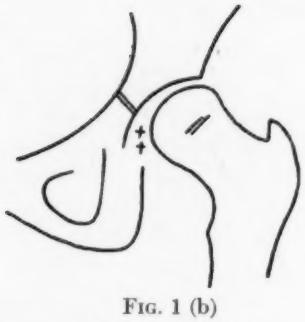


FIG. 1 (b)
Flattened Socket
(Through a too-thick socket floor.)

FIG. 1 (c)
Widened Socket
(Through ischium varum.)

adduct the hip joint and to lever the head out of the acetabulum, and so to lessen the normal pressure of the head against the socket floor, thereby preventing the normal deepening of the socket, thus resulting in a too thick socket floor; or, (2) the small amniotic sac is drawn tightly over the buttocks and bends one or both ischii inward.

Why the changes of pseudocoxalgia result. As a result of the flattening of the socket, the femoral head comes into contact with only a small portion of the acetabulum. From this certain changes follow:—

(1). The pull of the muscles acting on the hip joint tends to force the femoral head inward, and thus to rotate the head out, and to displace it laterally.

(2). The weight of the body, being concentrated on the small area in the lateral part of the head, causes diminished growth under this point,—

FIG. 2

hence flattening of the head and neck; and also causes increased growth on the medial side,—hence the protruding chin of bone which develops on the under surface of the neck.

Jansen's theory presupposes (1) a primary abnormality of the hip socket, which is shallow relatively to the femoral head; and (2) as a consequence, secondary anatomic changes in the head and neck of the femur—

the changes exhibited in pseudocoxalgia. The primary anatomic abnormality consists of:—

(1). Discrepancy between the curve of the femoral head and the curve of the hip socket.

(2). Flattening of the socket.

(3). Either ischium varum or a thickened bony floor.

Let us consider *seratim* these anatomic points.

FIG. 3

ISCHIUM VARUM

How are we to judge of the presence of ischium varum? Jansen considers this to be present when, in an otherwise symmetrical pelvis, the ischium runs obliquely from above and out, downward and in. But the direction taken by the ischium can be varied on the X-ray plate by tilting the patient or the tube, and it is difficult to say from the other parts of the picture whether the photograph is taken symmetrically or not. Fig. 2 shows a left-sided pseudocoxalgia, with a left ischium varum. Fig. 3 shows the same case three months later, with a right ischium varum.

Fig. 4 shows three views of a normal pelvis of a child. The one marked R and L was taken as symmetrically as possible; in that marked R the pelvis was tilted slightly to the right, and in that marked L to the left. These plates show how difficult it is to gauge the exact anatomic position of the ischium, and how erroneous may be the deductions based on the direction as shown by the X-rays. In judging of the symmetry of exposure

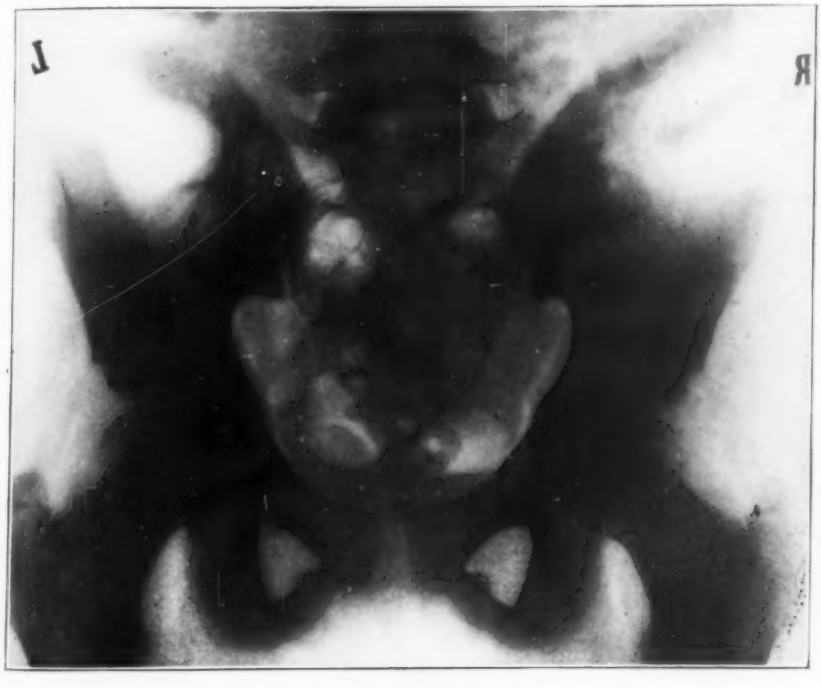


FIG. 4. (R and L)

in a radiogram of the pelvis, two points are worthy of notice: (1) Does the centre line of the sacrum and coccyx correspond with the interval between the two pubic bones? If the coccyx is used as a plumb line in this manner it will be seen that even the first photograph of Fig. 4 is not taken quite symmetrically. (2) In the truly symmetrical photograph the shadows cast by the socket line and the pelvic wall line should be the same on the two sides.

Fig. 5, a normal pelvis, illustrates these points. Incidentally in this picture note the direction of the epiphyseal lines on the two sides. Dr.

Jansen considers alteration in the direction of the epiphyseal lines to be one of the earliest radiographic changes seen in pseudocoxalgia. Here the right femur is slightly more abducted and perhaps rotated, and I believe the apparent difference in the direction of the epiphyseal lines to be an illusion.

FIG. 4. (R)

However, bearing in mind the difficulty of obtaining a symmetrical exposure, radiograms of pseudocoxalgia do often show ischium varum. In fact, I have not yet found a roentgenogram showing pseudocoxalgia in which I could convince an ardent supporter of the "Flattened Socket" theory that no ischium varum existed. On this point, I must confess that I cannot disprove Jansen's theory.

The converse of this, namely, the presence of ischium varum in conditions other than pseudocoxalgia, requires no proof. Ischium varum appears in most cases of tubercular arthritis of the hip, and Dr. Jansen does not dispute this.

THICKENED BONY FLOOR

The thickness of the bony floor of the acetabulum can be judged in the roentgenogram by the length of the strip of cartilage uniting the socket line and the linea innominata. This is not influenced much by asymmetrical exposure, as Fig. 4 shows.

Now, why should a thickening of the bony floor cause a flattening of the hip socket—in point of fact, does it? Fig. 6 shows a right pseudocoxalgia: neglect this for the moment. Observe the thickness of the left acetabular floor: it is certainly thicker than normal, yet the curve of the femoral head and the curve of the hip socket correspond and there is no flattening of the socket.

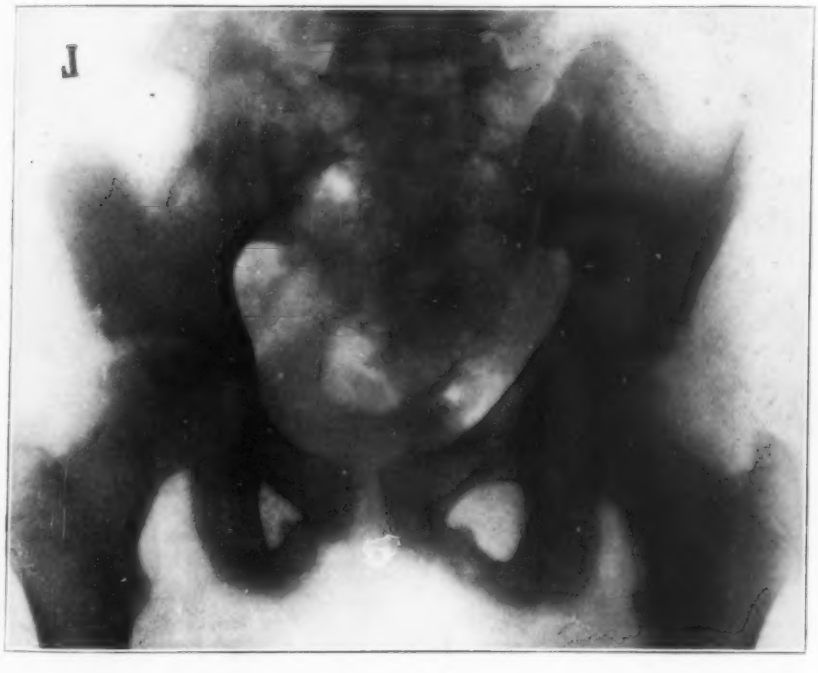


FIG. 4 (L)

DISCREPANCY BETWEEN THE CURVES OF THE FEMORAL HEAD AND THE SOCKET

There are pathologic conditions in which the curve of the femoral head forms a striking contrast to the hip socket curve, and yet the femoral

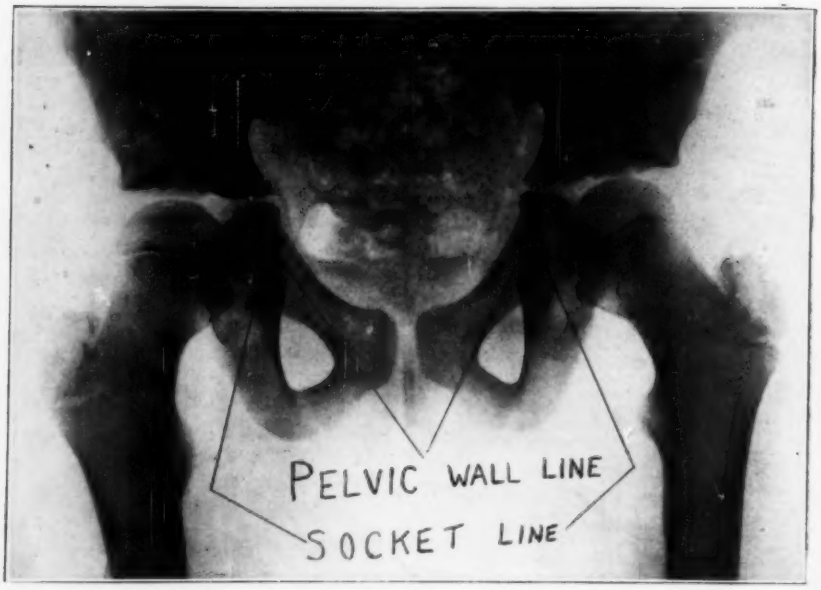


FIG. 5

FIG. 6

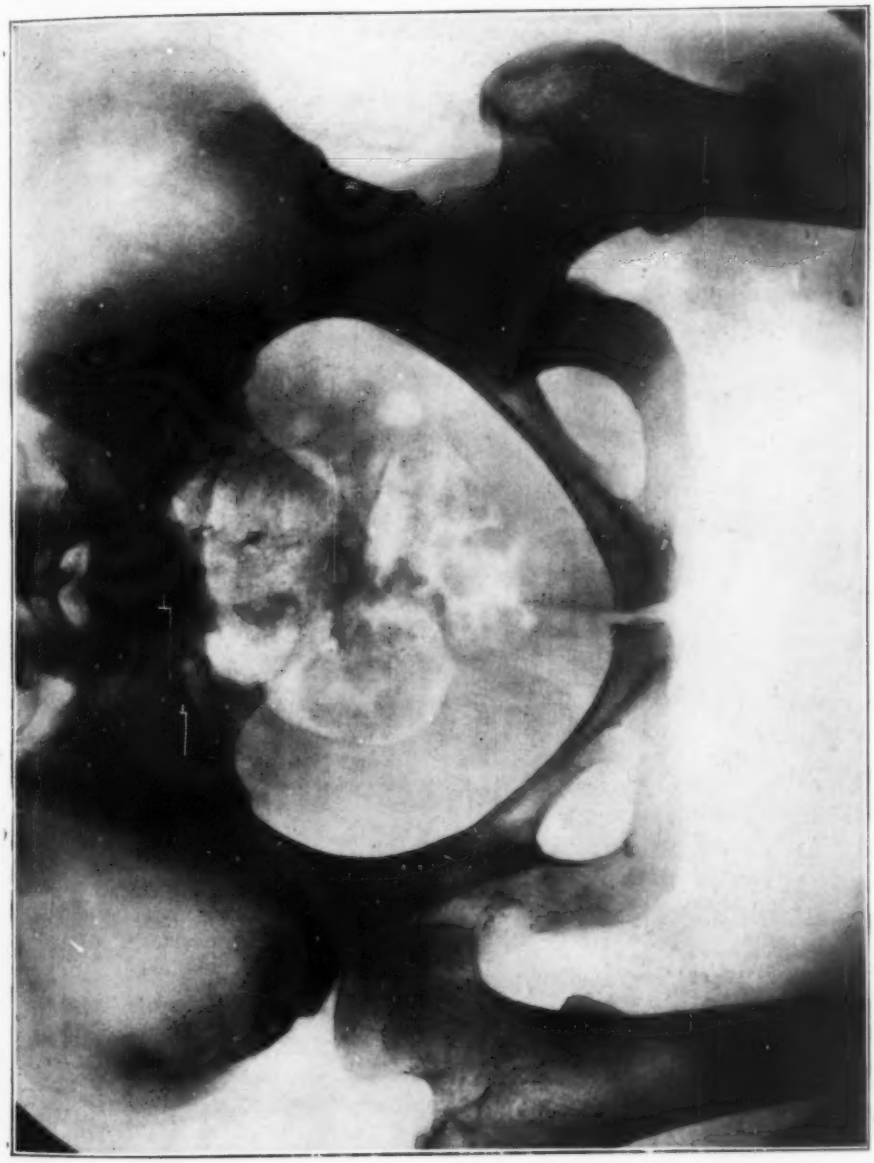


FIG. 7

head retains its normal characteristic shape and does not undergo the changes seen in pseudocoxalgia. In congenital dislocation of the hip, owing to the shelving roof of the acetabulum, the socket curve is always much less than the curve of the femoral head. Nevertheless, pseudocoxalgia is not a constant occurrence in an untreated congenital subluxation of the hip; it follows, not infrequently, a congenital dislocation of the hip

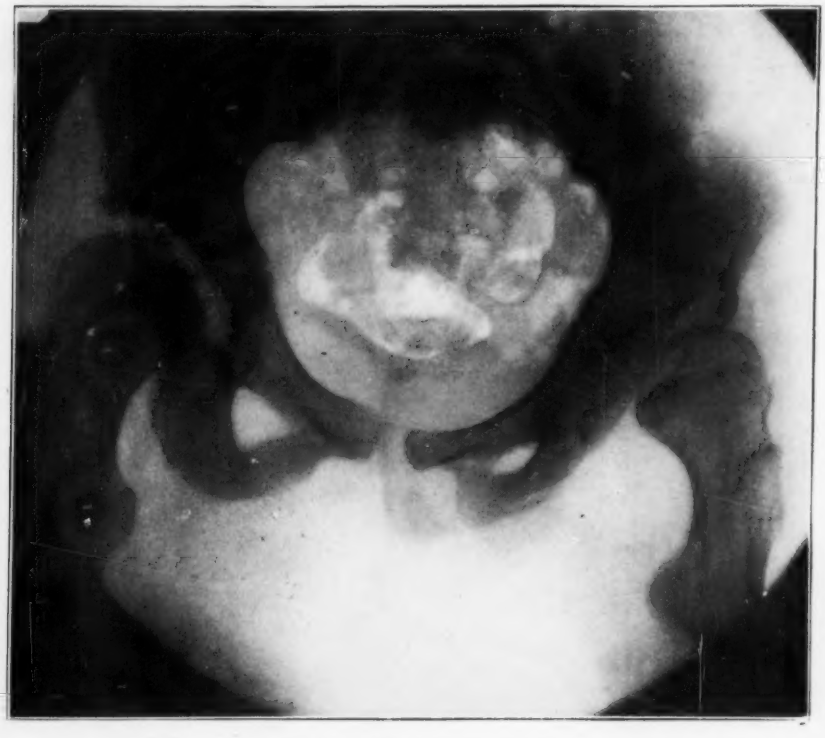


FIG. 8

which has undergone the traumatic act of reduction. Fig. 7 shows a congenital subluxation of the hip. Note the well-formed head and the complete contrast between the curves of the socket and the head. Fig. 8 shows the pelvis of a patient with severe infantile paralysis, in whom the hip joint could be dislocated and reduced at will. The head of the femur has developed normally in spite of the incongruity of the socket. Fig. 9 shows a cervical type of coxa vara. Note, again, the well-formed head and the great contrast between the curve of the head and the curve of the socket.

FIG. 9

FIG. 10

On the other hand, discrepancy between the curves of the femoral head and the socket does not always occur in pseudocoxalgia, even in the early stages, when Jansen's theory presupposes the discrepancy to be present in every case. Fig. 13 shows an early case of pseudocoxalgia in which the curves of the femoral head and of the socket exactly correspond.

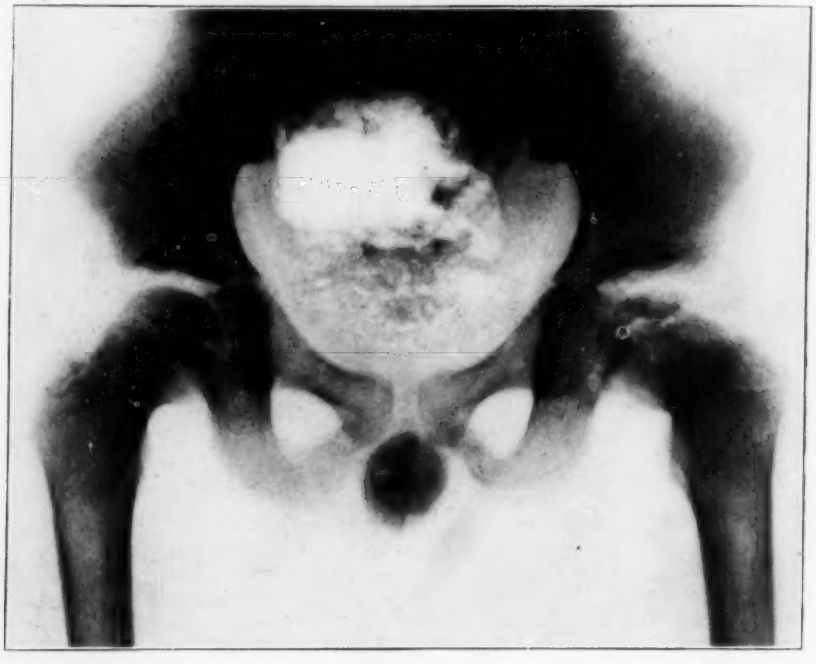


FIG. 11

FLATTENED SOCKET

By flattened socket one means that, as compared with the other side, the socket is (1) either widened—the depth being the same; or (2) its depth is diminished—the width remaining the same.

A flattening of the socket occurs in pseudocoxalgia, but I maintain that it is a late manifestation, and is not present from the commencement. Figs. 10, 11, and 12 are shown in inverse chronological order. Fig 10, taken two months ago, shows an appreciable difference in the hip sockets of the two sides; the right is flattened as compared with the left. Fig. 11, taken seven months ago, shows less difference. Fig. 12, taken eighteen months ago, shows so little difference that one might be pardoned for

imagining that there was no difference. This, however, is not a very early stage in the disease; there is not much flattening of the head, but already the changes in the neck of the femur are marked. Fig. 13 shows an earlier stage of pseudocoxalgia (left). Is there any difference in the depth of the socket on the two sides? I do not think there is.

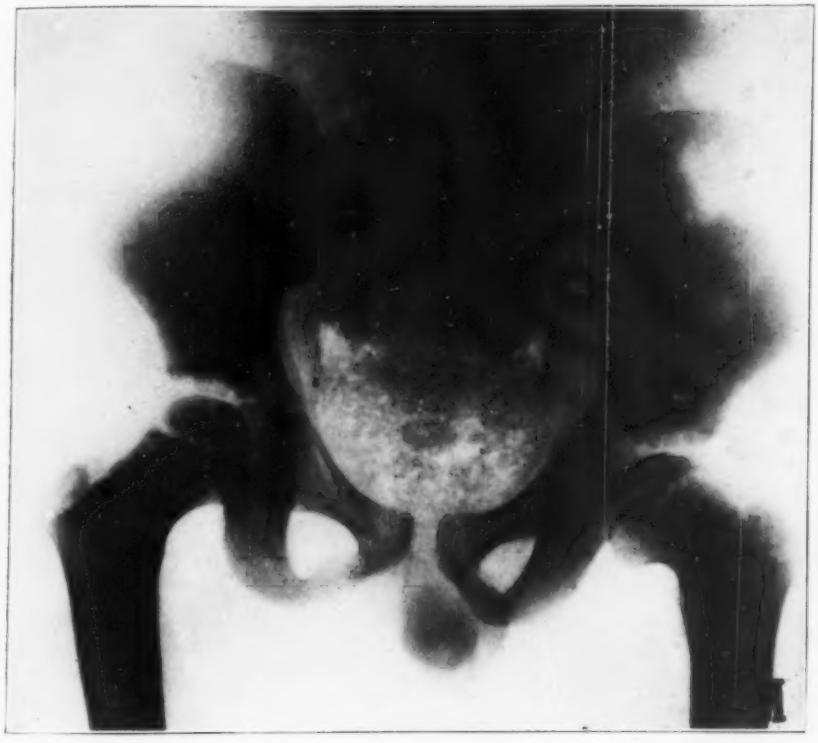


FIG. 12

A parenthesis may here be added. M. Calot believes that the hip joint of all cases of pseudocoxalgia shows some congenital malformation. In this photograph I cannot see any congenital malformation, but fear to state that such does not exist because Calot has hitherto been able to demonstrate malformations in the roentgenograms of every case of pseudocoxalgia submitted to him as normal. Observe that there is no flattening of the socket, and that the curve of the femoral head corresponds with the curve of the hip socket. The bony floor is not thick, but there is a slight ischium

FIG. 13

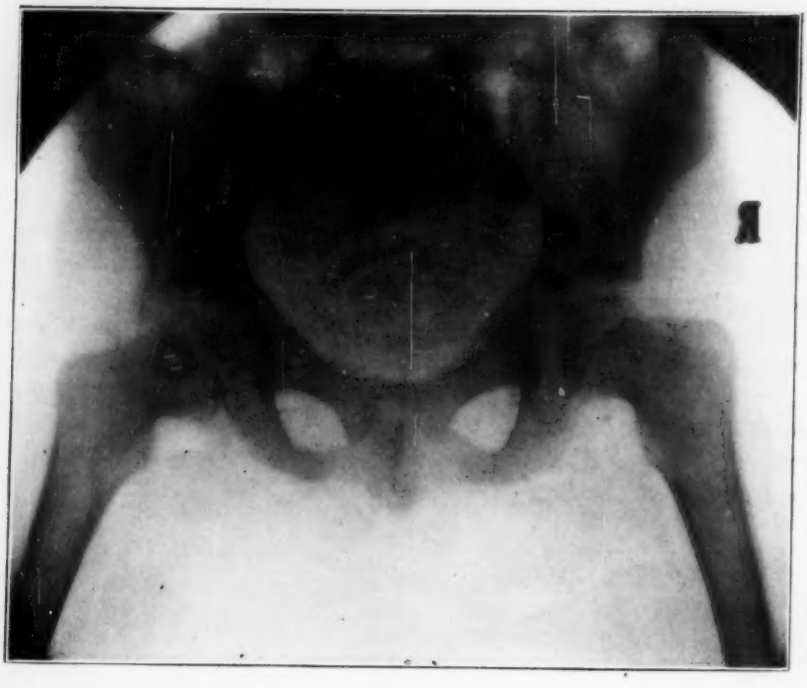


FIG. 14

varum. The photograph is a symmetrical one. Figs. 14 and 15 are subsequent radiograms of this case, taken six and eighteen months respectively after Fig. 13.

Let us for the moment allow that Jansen's theory is correct. If the flattening of the head is due to the pressure of the acetabular roof on a small part only of the head, early cases treated by recumbency, fixation, and traction to separate the joint surfaces should cease to progress. Most

FIG. 15

authors agree that the cycle of radiographic changes continues during, and in spite of, treatment. Figs. 16, 17, 18, 19, 20, 21 and 22 illustrate a case that was treated for much longer than usual on account of the persistence of muscular spasm. The patient was kept on a frame for eighteen months. The prolonged and thorough treatment did not prevent the typical series of changes in the neck and head of the femur.

FIG. 16

FIG. 17

FIG. 18

FIG. 19

FIG. 20

FIG. 21

Again: if the flattening of the head is due to pressure, it should occur in the lateral portion of the epiphysis, which alone is in contact with the acetabulum, according to the Jansen theory. Fig. 23 shows an early case with the flattening *commencing* in the mesial portion of the epiphysis.

Again: consider the age incidence. Why is it commoner between the ages of five and ten? If the cause is congenital, the condition should show

FIG. 22

itself as soon as the child commences to walk and to bear weight on the limb. It is hard to conceive that the changes can be delayed until the age of ten. Fig. 24 shows pseudocoxalgia commencing in a boy aged twelve. That it is an early case of pseudocoxalgia is proved by Fig. 25, taken fifteen months later.

FIG. 23

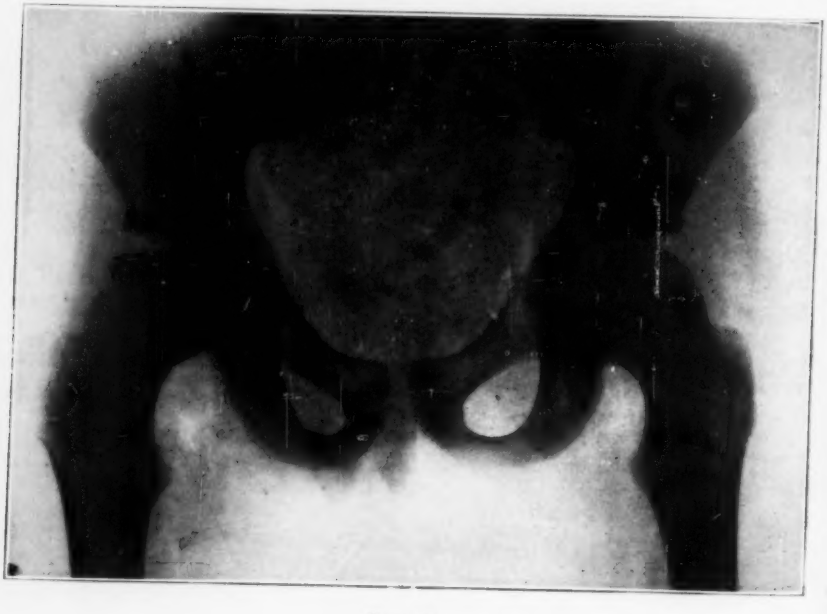


FIG. 24

CONCLUSION

Dr. Murk Jansen's theory of flattened hip socket cannot be accepted.

I wish to thank Mr. Harry Platt, of Manchester, for permission to review and utilise the radiograms of some thirty of his cases of pseudocoxalgia for the purpose of this investigation. I am also indebted to Dr. Fildes, radiologist to St. Thomas' Hospital, London, for many excellent radiograms.

FIG. 25

DR. JANSEN'S REPLY

Your paper has convinced me more than I have ever been of the fact that asymmetry of exposure to X-rays may cause differences in width of the bony socket floor and in the position of the ischium on the plate. I show X-ray plates which your paper induced me to make, confirming this: Fig. 26. The same pelvic skeleton photographed twice. The symmetrical exposure (the bottom one) shows the socket line and the innominate line at the same distance on both sides. The top one, for which the pelvis

FIG. 26

has been tilted to the right, shows the innominate line and the socket line wider apart on the left; on the other side, however, closer together than in the symmetrical picture. Fig. 27. Left half of pelvic skeleton photographed three times. In (a) the central X-rays have been made to coincide with the mesial plane of the imagined body. For (b) the Coolidge tube has been moved six inches to the left; for (c) the tube has been moved

FIG. 27 (a)

six inches to the right. In (b), (a) and (c) the distance between innominate line and socket floor measures five, twelve, and seventeen mm. respectively. Thus in your Fig. 6 the apparently thick socket floor without straightening of the socket line may be due to the asymmetrical exposure of that case. The tilted pelves of your Fig. 4 seem to show the same variable and reversible difference between the apparent width of the socket floor on symmetrical and asymmetrical exposure. Moreover, these plates demonstrate

that tilting of the pelvis may mislead to the assumption of ischium varum. Similarly in my Fig. 27 the ischium in the half pelvis in (b) makes an almost indisputable approach to the varus, in (c) to the valgus position. Of course this should not lead us to deny the occurrence of thick bony floor

FIG. 27 (b)

and ischium varum in some pelves under symmetrical exposure. An artist who can twist his face so as to imitate the features of hemiplegia, does not disprove the occurrence of facial paralysis. We should conclude that *only symmetrical exposure can furnish information concerning the width of bony floor and the occurrence of ischium varum.*

Thick bony floor and ischium varum can be best demonstrated by the straightened course of the socket line. In order to convince your audience, take a symmetrical X-ray plate with coxa plana on one side, make tracings of the socket lines, and fold the paper along the midline. And among your magnificent figures are excellent illustrations of straightened socket line through ischium varum.

The "well" side in cases of single coxa plana is rarely really "well." It generally shows slight thickening of the socket floor, either combined with slight ischium varum or not, together with initial symptoms of coxa plana. The beginner should therefore direct his attention to cases of coxa plana with a marked difference on the two sides.

FIG. 27 (c)

The existence of flattened socket once being established, the couple of forces which tends to rotate the head towards the horizontal position inevitably follows. This holds good provided the socket roof is present so that the forces are concentrated on the lateral portion of the head. In cases like Fig. 7, where the socket roof is sloping upward, the middle of the head is in contact with the socket floor and it must be assumed that a couple of forces medial to this place of contact counterbalances a couple lateral to it, and thus prevents the rotation of the head which ensues when the pressure is transmitted through the lateral portion of the head.

The roof in flattened socket often develops an extra indentation or excavation. Your Figs. 3, 13, 14 and 15 illustrate this beautifully. The indentation corresponds to the lateral portion of the head. I cannot see but that it is caused by an excess of functional pressure on the socket roof. If this assumption is justified, the roof indentation bears testimony to the fact that the mesial part of the socket is in default.

You ask: *Why does not every flattened hip socket (with a normal roof) develop coxa plana?* In other words: why does not every femoral head respond with rotation to the couple of forces which is evoked by flattened socket?

For the same reason not every child with everted feet develops knock-knees, although it makes the lateral portion of the growth cartilages near the knee joints bear excessive weight. It is well known that only in enfeebled children does the growth cartilage respond with decreased growth to increased pressure. The normal femur of the strong, unenfeebled child must in other words be expected to respond to the couple of forces which a flattened socket evokes by raising the femoral neck into the position of coxa valga. If, on the contrary, the bone is very soft, or in the case of a trauma, flattened socket is apt to lead to the development of coxa vara, as in Fig. 9 and in my Fig. 30 (*American Journal of Bone and Joint Surgery*, July, 1923). It should be remembered that all pressure in flattened socket comes from above only. In your case, trauma, and in my case extreme softness of the bone are, as I take it, to be made responsible. And I do not wonder that under the altered mechanical conditions arising from the bending or the breaking of the femoral neck the couple of forces does not make itself felt by rotation of the head.

Further: *Why does not the flattening of the head manifest itself as soon as the child commences to walk? Why is it commoner between the ages of five and ten?*

The characteristic flattening of head and neck are seen to develop only after the rotation of head and growth cartilage has been achieved. This takes some time, just as does the development of knock-knee. And, as I take it, the rate at which this rotation of the head takes place will depend largely on the enfeeblement of the child. The horizontal position of the head and growth cartilage opens up the possibility of their lateral displacement on the neck through the action of the horizontal component of functional forces. Any such lateral displacement of the head on the neck, which really is a mesial displacement of the neck below the head, involves risk to the nutrient vessels, especially to those issuing forth from the neck and perforating the growth disc. The reparative processes

in neck and head are inevitably attended by absorption of lime salts and increase of plasticity. These may be slow processes and demand time. The fragmentation of the head gives evidence of its lesser plasticity as compared with the neck, for which the better vascularisation of the latter may account. Axhausen has examined two cases of flattened head microscopically and found an impression fracture in either head. He ascribes it to a sudden check of blood supply, and not knowing how to account for it, adduces the hypothesis of bacterial emboli having caused it. Our cases do not furnish arguments for this hypothesis. Nor would it account for the flattened socket and the rotated head, the age incidence, the frequent coincidence with congenital dislocation of the hip in the same individual or the same family, or any of the characteristics of the condition. This sudden check of blood supply to the head may have been caused by injury to the blood vessels during the displacement of the head on the neck.

You maintain that flattened socket is a late manifestation and is not present from the commencement.

In support of your view you have presented Figs. 10, 11 and 12 in inverse chronological order. Now I have made tracings of the socket line of these figures and I have been unable to detect any increase of straightening in the socket line. So the straightened socket line, the flattened socket, was there at the very commencement, and during the flattening of the head it shows no additional flattening appreciable to me. Neither does the patient of the beautiful series of your Figs. 16 to 22 show an increase of ischium varum in the lapse of nineteen months. Nor do I see how in coxa plana with thick bony floor (as in Figs. 10, 11, 14, 15, and 16 of my paper quoted in the above) flattening of the head can be made responsible for the thickness of the floor. But the assumption that the flattening of the socket is the primary thing and inevitably evokes the couple of forces creates for me a logical sequence of events.

You ask: *Is there any difference in the hip sockets of your Fig. 13?*

I have made tracings of the socket lines of Fig. 13 and find the left socket line less curved than the right. The same I find in Fig. 15, taken a year later.

Your Fig. 13 shows the initial stage of coxa plana on both sides. I believe that on the right it is due to slight thickness of the bony floor, and that the further development into coxa plana on the left is due to the additional ischium varum on that side.

You ask: *Why in Fig. 23 the flattening of the head commences in the mesial portion of the epiphysis: and add that it should occur in the lateral portion.*

Before the rotation of the head, the pressure is, indeed, concentrated on its lateral portion; but as the rotation proceeds, the mesial portion of the head gets its share. Now Fig. 23 has passed through the initial stage, the growth disc approaching the horizontal line, and showing head-in-neck position. Moreover, vascular lesions may in this stage have caused differences in the distribution of lime salts in the various parts.

In conclusion, you believe that if flattened socket were the cause of flattened head, the condition should not be as refractory to treatment as it is. I believe you are wrong there. As long as the discrepancy between the joint surfaces persists, abnormal stimuli will be in action. In cases of slight incongruence, indeed, we often see the deformation checked even before the initial stage is terminated, as is very frequently seen in the "well" side of single coxa plana. But in cases of serious socket flattening the cause is not removed by our measures and thus the effect not checked.

This, as some of the other points, may find better elucidation in my paper in the *American Journal of Bone and Joint Surgery*, July, 1923.

All in all, Dr. Perkins, though I cannot agree with your assumption that flattening of the head is the primary occurrence in the development of coxa plana, and flattening of the socket is secondary to it, I feel that your keen observations and loyal criticism constitute a valuable contribution towards our knowledge of this fascinating problem. That is why I venture to propose that you should not only read and explain my views to the President and members of the Orthopaedic Association but also to publish your paper and my reply so as to bring our considerations before a larger forum.

LITERATURE

1. Platt, Harry: *British Journal of Surgery*, Vol. IX, No. 35, 1922.
2. Calot: *Presse Médicale*, Jan. 14, 1922.
3. Jansen, Murk: *The Journal of Bone and Joint Surgery*, Vol. V, No. 3, July, 1923.

A LOCALIZED AFFECTION OF THE SPINE SUGGESTING OSTEOCHONDRITIS OF THE VERTEBRAL BODY, WITH THE CLINICAL ASPECT OF POTT'S DISEASE*

BY JACQUES CALVÉ, M.D., BERCK, FRANCE

Chirurgien en Chef de la Fondation Franco-Americaine de Berck Plage, France

In this paper are submitted two observations, one of a case of my own, and one of a case of my friend, Dr. Brackett, of Boston, who has been good enough to allow me to use the notes and illustrations of his case. They both occurred in patients in private practice and were observed carefully from the time of their first symptoms until their evident cure. Both cases were believed, during their entire evolution, to be Pott's disease, and were treated as such.

Observation 1. P. F., 2½ years of age. Onset: November, 1921, insidious, gradual, accompanied by pain in the back, and stiffness, with the appearance of a small knuckle in the dorsal region which rapidly increased. Parents consulted a specialist, who made the diagnosis of Pott's disease and sent the child to the Riviera. The case came under my observation for the first time in May, 1922, six months after the onset. At this time there were the usual symptoms of Pott's disease with a sharp knuckle. The child was difficult to manage and, the diagnosis appearing evident, it did not seem necessary to have an X-ray picture taken at that time, and the case was treated at Berck by hyperextension in a recumbent position until January, 1924. The knuckle disappeared progressively, no abscess threatened at any time, nor were there any symptoms, at any time, suggesting compression of the spinal cord. The child made a recovery without deformity and now walks like a normal child, and is wearing, at present, a celluloid jacket as a matter of protection.

Observation 2. F. M., 7 years of age. Patient presented usual symptoms of an early spinal tuberculosis. No history of fall or injury other than those incident to the life of a healthy and active boy. There were early premonitory symptoms of tire, disinclination for prolonged play, etc., but not sufficient to call attention to them at the time; later,

* Presented at the meeting of the British Orthopaedic Association, Bologna, Italy, September 22, 1924.

very marked sensitiveness to all motion, night cries, spasm with rigid spine, forward stoop in standing, and a small sharp knuckle of one spinous process. Treatment by plaster jackets at first, and with recumbency for several months, then gradual resumption of limited activity. After two

CASE 1

or three months pain and sensitiveness entirely disappeared, and the patient has had no symptoms since. For the past three years he has lived the active life of a normal boy, taking part in games, but still wearing the plaster jacket. Between the first and the second year the knuckle disappeared; none can be seen now, but one spinous process can be felt to be slightly prominent.

As seen from a clinical point of view, these were cases of dorsal Pott's disease. Neither developed an abscess or symptoms of spinal cord compression, the evolution was rapid, and the disease was, perhaps, cured in a shorter period than usual. Nevertheless, at the time this did not seem a sufficient reason for doubting the diagnosis of the tubercular nature of

CASE 1. Roentgenogram taken six months after Figure 1, showing a greater calcification.

the affection, nor was there any doubt of the diagnosis until the evidence of the first roentgenograms was considered. As has already been stated, my patient was extremely difficult to manage, which prevented a roentgenogram being taken at the beginning of the treatment. When, from a clinical point of view, it was considered that the disease was cured, a

roentgenogram was taken to confirm this clinical diagnosis of cure, and at once the abnormal aspect of the picture was apparent and raised a doubt of the original diagnosis. As there had appeared in an American journal at the same period a roentgenogram of the case treated by Dr. Brackett, which bore a striking resemblance to that of my own case, I obtained a picture of this case, which is the one submitted above.

A study of the two roentgenograms shows, in my opinion, the difference between them and pictures taken of a case of true Pott's disease.

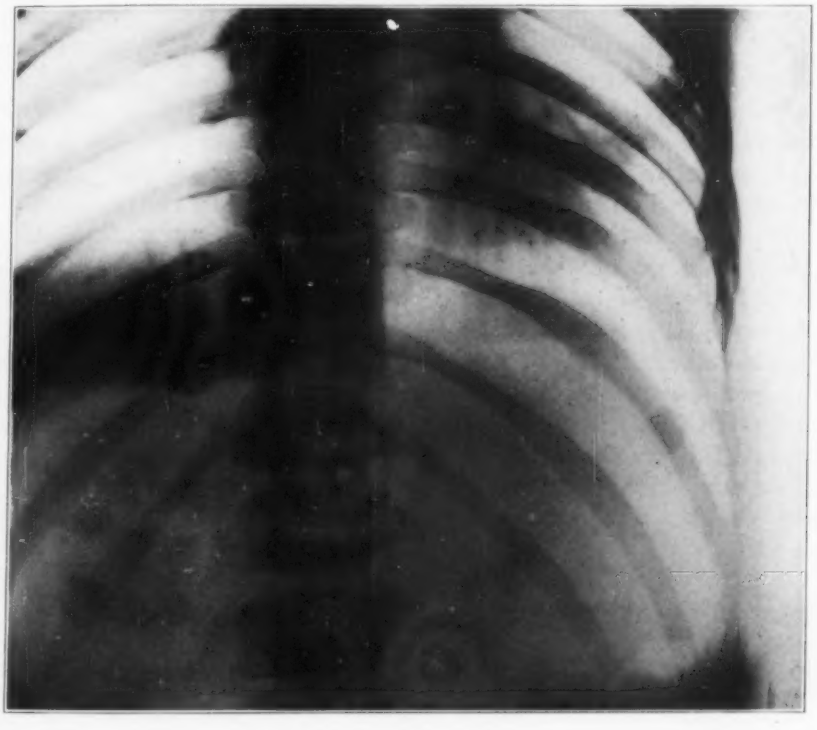
CASE 2

1. In these two cases the lesion attacks only one vertebra (there is but one pedicle). The lamellar aspect of the osseous nucleus, regular in one case, irregular in the other, and slightly wedge-shaped, can be found in Pott's disease (especially in the lumbar region), but in Pott's disease there are always at least two pedicles, at least two of the vertebrae being affected or destroyed. This cuneiform shape always indicates the total destruction of the intervertebral disc.

2. In striking contrast here is the absolutely intact condition of the adjacent discs above and below the diseased vertebra.

3. The cartilage is thicker and there is a neoformation of this tissue. The transparent part above and below the lamellar osseous nucleus is at least a third higher than it is normally. (This is never seen in tuberculosis, which is markedly destructive of cartilage tissue.)

4. Greater opacity is to be remarked, which indicates that the bone density has increased. This characteristic is especially noted in the observation of Case 2, but is also perceptible in Case 1.



CASE 2

With the evidence of this abnormal characteristic, tubercular tests were made under such conditions that all possibility of a mistake was eliminated in both cases. The tests were negative. The Wassermann test was also made and resulted in negative findings in both cases. We are, therefore, justified in ruling out a diagnosis of tubercular infection in either of these two cases, and this observation, combined with the

similarity of the roentgenograms, justifies the consideration of these two cases in the same category. It might seem presumptuous on my part to suggest a pathologic entity from the observation of two cases only, but one may advance a suppositional diagnosis while waiting for other observations to corroborate these findings, and it is hoped that other observations will be stimulated by this short paper.

In what type of disease can these two cases be catalogued? Tuberculosis and syphilis must be eliminated. Neither can traumatism (that is, Kümmel's disease) be suspected, for in both cases the parents were positive that there had been no serious injury or a fall previous to the first symptoms. The idea of congenital malformation must also be eliminated.

The clinical history of both cases is manifestly and incontestably that of an affection developed after birth. The cases also show a regeneration of bone in the later stages of the convalescence, and in Case 2, an increase could be observed in roentgenograms taken two or three years apart. An infectious origin is, on the other hand, more probable. In Case 2 there were no observations on this point. In Case 1 the patient had an attack of enteritis with fever at the time the back symptoms appeared. It is impossible not to recognize by the roentgenograms and the clinical manifestations some connection between these two cases and coxa plana, Legg-Calvé's disease, infantile osteochondritis of the hip, as well as Koehler's disease. Here also is found the reverse of the usual formula (upon which I have already insisted in reference to coxa plana) which may be thus expressed: "less bone, more cartilage." In this the same density of bony substance is found which is the rule in Koehler's disease.

The affection which I have just submitted to you is, I believe, to the spinal column what coxa plana is to the hip, and what Koehler's disease is to the foot.

REGIONAL AND FIELD BLOCK ANESTHESIA IN EXTREMITY SURGERY*

BY C. F. EIKENBARY, M.D., F.A.C.S., AND
MITCHELL LANGWORTHY, M. D., SPOKANE, WASHINGTON

The following report is not made with the idea of presenting anything new or original to this Association. Regional or field block anesthesia has been known and used for many years, but its use is far from general and the value of the method is apparently not appreciated by the general run of surgeons. It is perfectly evident that regional anesthesia is not going to supplant ether as an anesthetic. It is equally evident that there is a definite field for regional anesthesia, and that many patients would be far better off if this type of anesthesia were used. There are very few of us who have not seen patients do poorly under ether or under ether with any of its modifications. Not infrequently we come across conditions that require operative work, but advise against operation because of the danger from the anesthetic. Shock from bone operations is all too frequent. Few, if any, procedures are productive of more shock than are extensive bone operations. In none of the cases included in the following report has there been any shock.

So far as our experience goes, we may make the following claims for regional anesthesia.:

1. Given a knowledge of the nervous anatomy, it is a very safe anesthetic.
2. In our experience it is not productive of shock.
3. It is an effective anesthesia.
4. The difficulties of administration are easily overcome.
5. It may be safely given to a large number of patients where a general anesthetic would not be safe.
6. There is no age limit, excepting in young children where the difficulties would be obvious.
7. The cost is too trivial to be considered.

The technique used is that laid down by Braun, Labat, and others. We have not tried to vary from this method, finding it perfectly satisfactory in every way. Novocain has been used exclusively.

* Presented at the Annual Meeting of the American Orthopedic Association, May, 1924.

The following report will show that almost every type of operation on the extremity has been performed under this type of anesthesia.

SUMMARY

Total No. of Patients, 144.
Total No. of Regional Anesthesias, 164.

Brachial Plexus Blocks, 38.
Degree of Anesthesia, 37 perfect.
One Required Gas during Manipulations of Fracture.

Sciatic and Internal Saphenous Blocks, 51.
Degree of Anesthesia, 48 perfect.
1—Fair.
2—Unsatisfactory (on same patient).

Combined Sciatic, External Femoral Cutaneous, Anterior Crural, Obturator Blocks, 4. All perfect.

Field Blocks, 71.
Degree of Anesthesia, all perfect but one.

FIELD BLOCK

No.	*Age*	*Operation*	*Anesthesia*
1	28	Removal of semilunar cartilage	Perfect
2	26	Mayo operation for bunion—unilateral	Perfect
3	16	Removal of semilunar cartilage	Perfect
4	16	Brackett's reconstruction operation, head of femur, for epiphyseal separation	Perfect
5	43	Mayo operation for bunions—bilateral	Perfect
6	18	Mayo operation for bunions—bilateral	Perfect
7	65	Mayo operation for bunions—bilateral	Perfect
8	40	Fractured clavicle—nonunion	Perfect
9	18	Removal internal semilunar cartilage	Perfect
10	30	Removal of spur and sub-Achilles bursa	Perfect
11	40	Comminuted fracture—old fracture clavicle	Perfect
12	32	Lengthening extensor tendon of toe	Perfect
13	48	Mayo operation for bunions—bilateral	Perfect
14	25	Acromio-clavicular separation. Open reduction	Perfect
15	28	Exostosis amputation stump, femur	Satisfactory
16	36	Mayo operation, bunions—bilateral	Perfect
17	62	Acromio-clavicular separation. Open reduction and suture	Perfect
18	40	Mayo operation for bunions—bilateral	Perfect

FIELD BLOCK—*Contined*

No.	*Age*	*Operation*	*Anesthesia*
19	77	Fracture patella. Open reduction and suture	Perfect
20	45	Mayo operation for bunions—bilateral	Perfect
21	34	Mayo operation for bunions—bilateral	Perfect
22	35	Removal internal semilunar cartilage	Perfect
23	24	Removal internal semilunar cartilage	Perfect
24	57	Reconstruction operation for fracture of neck of femur	Perfect
25	29	Mayo operation for bunion—unilateral	Perfect
26	37	Removal internal semilunar cartilage	Perfect
27	24	Old fracture of clavicle—open reduction	Perfect
28	35	Exploration tumor of clavicle	Perfect
29	29	Mayo operation for bunions—bilateral	Perfect
30	24	Rupture of Achilles tendon—old	Perfect
31	20	Amputation thigh—lower third	Perfect
32	24	Removal of coccyx	Perfect
33	42	Mayo operation for bunions—bilateral	Perfect
34	24	Amputation of thigh, middle third	Perfect
35	20	Mayo operation for bunions—bilateral	Perfect
36	35	Mayo operation for bunions—bilateral	Perfect
37	46	Mayo operation for bunions—bilateral	Perfect
38	40	Amputation through 5th metacarpal	Perfect
39	50	Acromio-clavicular separation. Open reduction and suture	Perfect
40	48	Mayo operation for bunion—unilateral	Perfect
41	55	Mayo operation for bunion—unilateral	Perfect
42	51	Removal of internal semilunar cartilage	Perfect
43	69	Sterno-clavicular separation—open reduction	Perfect
44	66	Mayo operation for bunions—bilateral	Perfect
45	30	Mayo operation for bunions—bilateral	Perfect
46	32	Removal internal semilunar cartilage	Perfect
47	47	Mayo operation for bunions—bilateral	Perfect
48	23	Mayo operation for bunion—unilateral	Perfect
49	50	Mayo operation for bunion—unilateral	Perfect
50	8	Amputation of little finger through metacarpal	Perfect
51	32	Removal of loose body from knee joint	Perfect
52	45	Mayo operation for bunions—bilateral	Perfect

BRACHIAL BLOCK

No.	*Age*	*Operation*	*Anesthesia*
1	26	Cuneiform resection of carpus to correct deformity	Perfect
2	40	Fracture radius and ulna—open reduction	Perfect
3	45	Removal of subdeltoid bursa	Perfect
4	30	Exploration of brachial plexus in axilla	Perfect
5	32	Step operation—non-union radius and ulna	Poor. Some Nitrous Oxid Used.

BRACHIAL BLOCK—*Continued*

No.	*Age*	*Operation*	*Anesthesia*
6	70	Radical operation—chronic osteomyelitis of ulna	Perfect
7	24	Resection of elbow	Perfect
8	63	Resection of elbow	Perfect
9	65	Fracture elbow—open reduction	Perfect
10	45	Exploration brachial plexus beneath clavicle. (Small field block)	Perfect
11	30	Cuneiform resection of humerus to correct carrying angle	Perfect
12	49	Neurolysis—median and ulnar nerves in upper arm	Perfect
13	15	Excision of head of radius for fracture	Nitrous Oxid Used During Manipulation. (No Adrenalin added to Novocain)
14	23	Comminuted fracture elbow—open reduction	Perfect
15	14	Loose body in elbow—removal	Perfect
16	24	Compound comminuted fracture radius and ulna. Débridement and suture	Perfect
17	24	Removal of sequestrum from radius	Perfect
18	24	Open reduction malunion radius (same patient, different dates)	Perfect
19	16	Arthrotomy elbow—removal loose body	Perfect
20	58	Bone graft for ununited fracture of elbow	Perfect
21	11	Comminuted fracture elbow—open reduction	Perfect
22	49	Open reduction ununited fracture of metacarpal	Perfect
23	60	Ununited fracture radius and ulna. Step operation	Perfect
24	18	Fracture radius—open reduction	Perfect
25	48	Comminuted fracture elbow—open reduction	Perfect
26	43	Comminuted fracture of elbow	Perfect
27	19	Fracture radius and ulna—open reduction	Perfect
28	40	Suture of ulnar nerve—forearm	Perfect
29	17	Musculo-spiral paralysis—tendon transplantation	Perfect
30	31	Resection and suture musculo-spiral nerve	Perfect
31	69	Fracture surgical neck of humerus—reduction by manipulation	Perfect
32	60	Fracture surgical neck of humerus—reduction by manipulation	Perfect
33	63	Fracture surgical neck of humerus—reduction by manipulation	Perfect
34	22	Exploration of brachial clavicle below clavicle	Perfect
35	24	Disarticulation of shoulder	Perfect
36	34	Removal of sequestra from radius and ulna	Perfect
37	71	Malunion from old Colles' fracture	Perfect
38	11	Fracture—middle of humerus—manipulation and reduction under fluoroscope	Perfect

SCIATIC BLOCK

No.	*Age*	*Operation*	*Anesthesia*
1	22	Pedunclated flap from left thigh to right leg. (Field block on thigh)	Perfect
2	16	Cuneiform resection of foot, arthrodesis and tendon transplantation of peronei	Perfect
3	47	Radical operation—chronic osteomyelitis tibia	Perfect
4	50	Radical operation, chronic osteomyelitis tibia	Perfect
5	55	Spiral fracture tibia—open reduction	Perfect
6	15	Astragalectomy	Perfect
7	40	Excision of Exostoses of Ankle Joint	Perfect
8	37	Amputation leg—lower third	Perfect
9	25	Amputation leg—middle third	Satisfactory; Had some pain.
10	50	Old fracture of os calcis. Removal of exostosis	Perfect
11	40	Amputation leg—middle third	Perfect
12	40	Amputation leg—upper third	Perfect
13	22	Amputation leg—middle third	Perfect
14	40	Resection of sciatic and internal saphenous for neuroma	Perfect
15	35	Removal of exostosis of astragalus. Cuneiform resection tarsus	Perfect
16	23	Claw foot	Perfect
17	30	Chronic osteomyelitis tibia. Radical operation	Perfect
18	73	Old fracture ankle—open reduction	Perfect
19	27	Bone graft for ununited fracture of tibia	Perfect
20	33	Chronic osteomyelitis tibia. Radical operation	Perfect
21	53	Cuneiform resection adult club foot	Perfect
22	28	Chronic osteomyelitis—radical operation	Perfect
23	40	Amputation—upper third tibia	Perfect
24	40	Amputation leg—middle third	Perfect
25	16	Cuneiform resection of tarsus	Perfect
26	30	Chronic osteomyelitis tibia—radical operation	Perfect
27	61	Ununited fracture tibia—bone graft	Perfect
28	19	Excision os calcis spurs—bilateral	Perfect
29	25	Fracture tibia and fibula—reduction under fluoroscope	Perfect
30	25	Fracture tibia and fibula—reduction under fluoroscope	Perfect
31	25	Fracture tibia and fibula—open reduction (Same patient—different dates)	Perfect
32	38	Cotton's operation for old fracture of os calcis—right	Perfect
33	38	Cotton's operation for old fracture of os calcis—left (Same patient).	Perfect
34	22	Tendon transplantation in foot	Perfect
35	14	Cuneiform resection of tarsus	Perfect
36	35	Removal of large tumor from ankle	Perfect
37	50	Claw foot—stretching with Thomas wrench	Perfect
38	18	Marked valgus with flat foot—cuneiform resection	Perfect
39	68	Malunion fracture tibia and fibula—open correction	Perfect

SCIATIC BLOCK—*Continued*

No.	*Age*	*Operation*	*Anesthesia*
40	16	Congenital club foot—cuneiform resection	Perfect
41	42	Lengthening of tendo Achillis—stretching with Thomas wrench	Perfect
42	30	Lengthening Achilles tendon—stretching foot	Perfect
43	40	Compound fracture tibia and fibula—débridement and suture	Unsatisfactory. Gen. Anesthesia necessary.
44	40	Same as "40." Manipulation under fluoroscope	Unsatisfactory. Gen. Anesthesia necessary.
45	20	Lengthening Achilles tendon and wrenching foot, plantar fasciotomy	Perfect
46	27	Fracture os calcis—open reduction	Perfect
47	40	Chronic osteomyelitis tibia—radical operation	Perfect
48	68	Fracture tibia and fibula—open reduction	Perfect
49	35	Compound comminuted fracture of tibia and fibula. Débridement and partial suture	Perfect
50	39	Claw foot—resection of tarsus and transplantation of tendons	Perfect

COMBINED SCIATIC, ANTERIOR CRURAL, EXTERNAL FEMORAL CUTANEOUS AND OBTURATOR

No.	*Age*	*Operation*	*Anesthesia*
1	20	Cuneiform resection lower end of femur for flexion deformity of knee	Perfect
2	35	Patella splitting operation—repair of anterior crucial ligament	Perfect
3	65	Synovectomy of knee—patella splitting operation	Perfect
4	58	Resection knee joint to correct flexion deformity with ankylosis	Perfect

A CONTRIBUTION TO THE KNOWLEDGE OF PATHOGENESIS OF SKELETAL TUBERCULOSIS

BY ANATOLE KOLODNY, M.D.

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The pathology of skeletal tuberculosis would be an entirely unknown field if it were not for the studies of orthopaedic and general surgeons. To the clinician more than to the pathologist we are indebted for the clearing up of this important field. The work of Volkmann, F. Koenig, F. Krause, and N. Senn is still to be considered as authoritative, in spite of the twenty-five to forty-five years since it was done. It was Koenig who first suggested the embolic theory of skeletal tuberculosis. He was led to this suggestion by the frequent wedge-shaped form of the sequesters. The tubercle bacillus, brought in by the blood stream, stops at a narrowing or a blind ending of a capillary and a tubercle results. Krause and Mueller confirmed experimentally, by injection of tubercle bacilli into the blood stream, the probability of this theory. Why, then, does the tubercle bacillus stop usually in the epiphyses and not in the diaphyses of the bones? This question could not be answered until Lexer showed in 1904 that the capillaries of the epiphyseal, metaphyseal and diaphyseal (from the nutrient artery) blood systems in young individuals do not anastomose, *i.e.*, that these are end-vessels in the sense of Cohnheim. The finer ramifications of the blood vessels of each of these blood systems are directed toward the epiphyses, and this explains partially the location of the primary foci in tuberculous involvement. There are, however, finer points which cannot be readily explained by all these facts. Why, then, are certain skeletal regions more disposed to be the seat of primary foci than others? Why, for example, do we seldom, if ever, find a primary focus of the external and posterior aspect of the head of the humerus, of the subtrochanteric fossa of the neck of the femur, of the posterior aspect of a vertebral body, when the sulcus bicipitis humeri, the "*Schenkelhalsspitze*" (lower angle of the head of the femur) and the anterior aspect of the vertebral body are the most frequent seat of the primary focus? If the hematogenous-embolic theory is right, then we should find some anatomic facts which would distinguish these most frequent seats of the primary foci. This hypothesis was in our mind when we turned to a more detailed

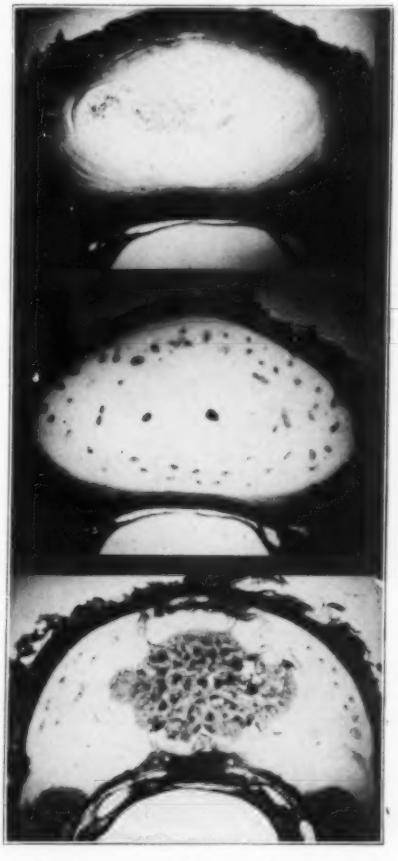
study of the blood supply of the skeleton. The old way of study of the blood supply of the skeleton shown by Lexer—an injection of the blood vessels with some metallic substance throwing a shadow on the X-ray screen—we consider as insufficient for the study of the finer ramifications of the blood vessels. Injection of the blood vessels with subsequent clearing of the bone after the technique of Spalteholtz gives sometimes beautiful results. We believe, however, that both of these methods should be supplemented by sectioning of the bone and a microscopic study and reconstruction of serial sections. This is the only dependable way to decide about the terminal character of the blood vessels. In our study we made use of all three of these methods—injection with roentgenographic study, injection with clearing, and microscopic study. For gross demonstration of the finer points of the blood supply of such important regions as the "Schenkelhalsspitze" we used reconstructions in wax from microscopic sections. Such models have all the advantages of reconstruction models in embryology, easily impressing the observer and giving him at a few glances the whole picture of the arrangement of the blood vessels in a certain region, notwithstanding the complicated details.

We have confined our study to the spine, hip, knee, shoulder, and costal cartilage. These regions comprise about 87% of all cases of tuberculosis of bones and joints.

The Spine. Koenig and Krause first noticed that in tuberculosis of the spine the anterior aspect of the vertebral body is the most frequent seat of the primary involvement. Here right beneath the fibroperiosteal layer of the anterior longitudinal ligament we, as a rule, find the first indications of tuberculosis. Usually multiple small foci appear here, so that they give to the anterior aspect of the vertebra a worm eaten appearance, which the French authors express well by the word "vermoulure." Next in frequency we find the epiphyses of the vertebrae, which are covered by the intervertebral disc. Seldom is the primary focus detected on the arches of the vertebrae and the dorsal aspect of the vertebral body. The middle of the vertebrae as seat of the primary focus can be looked upon as a real rarity.

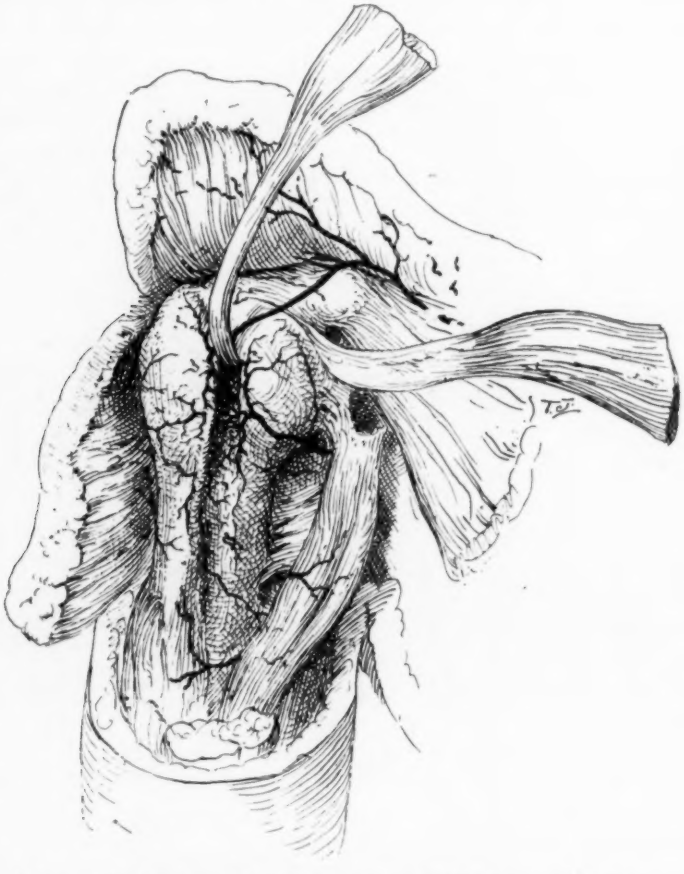
The blood supply of the spine has been dealt with by only a few authors. Fick speaks about arteries supplying the vertebral bodies and others supplying the intervertebral discs. The results of our study of the blood supply of the spine are illustrated by Fig. 1. In relation to the blood supply we divide each entity of the spine,—the vertebral body and intervertebral disc forming together an entity—into three regions. (a) The intervertebral disc does not contain any blood channels. Serial

sections of intervertebral discs of new-born led us to this conclusion. (b) The epiphysis of the vertebra shows blood vessels extending from the main blood vessels of the vertebral body. No independent blood vessels could be found in young individuals in this region. (c) The main nucleus of the vertebral body is supplied mainly by independent vessels entering into it from beneath the anterior longitudinal ligament. This type of blood



No. 1. Photomicrographs of cross sections 200 mcr. thick of a vertebra of a new-born human. On the top—section through the intervertebral disc (a complete absence of vessels, remnants of the chorda dorsalis). In the middle—section through the epiphysis of the vertebra. On the bottom—section through the vertebral body.

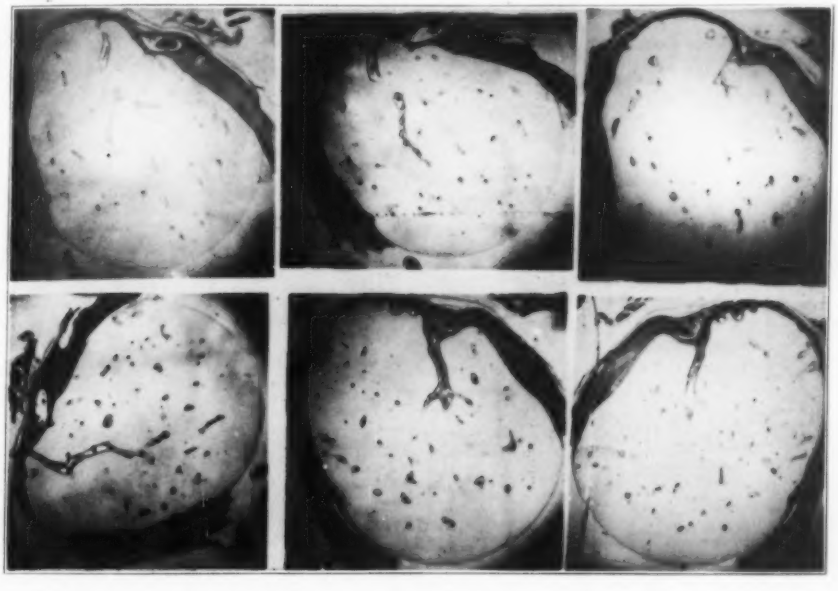
supply is met with all through the spine. We readily see from it that there is a parallelism between the frequency with which a certain region of the vertebral unit is primarily involved in tuberculosis and the richness of the blood supply of the respective region.



No. 2. The blood supply of the upper end of the humerus. Newborn human. Carmin-gelatin injection. The blood vessels enter the bone in and about the sulcus bicipitis humeri.

The Shoulder. A similar parallelism between the frequency with which certain skeletal regions are affected and their blood supply we notice in osseous tuberculosis of the shoulder. Here the bone primarily involved is usually the head of the humerus. The primary focus here is

usually found in and about the sulcus bicipitis humeri. From here the destructive process extends to the medial aspect of the head, to the tuberculus majus, and even to the diaphysis. When we turn to a study of the terminal ramifications of the blood vessels supplying the shoulder joint, we easily find the anatomic basis for this peculiar localization of the primary focus. The shoulder joint is supplied with an abundant anastomotic net composed of branches of the vasa transversa scapulae, vasa subscapularia, vasa circumflexa scapulae, and vasa circumflexa humeri.



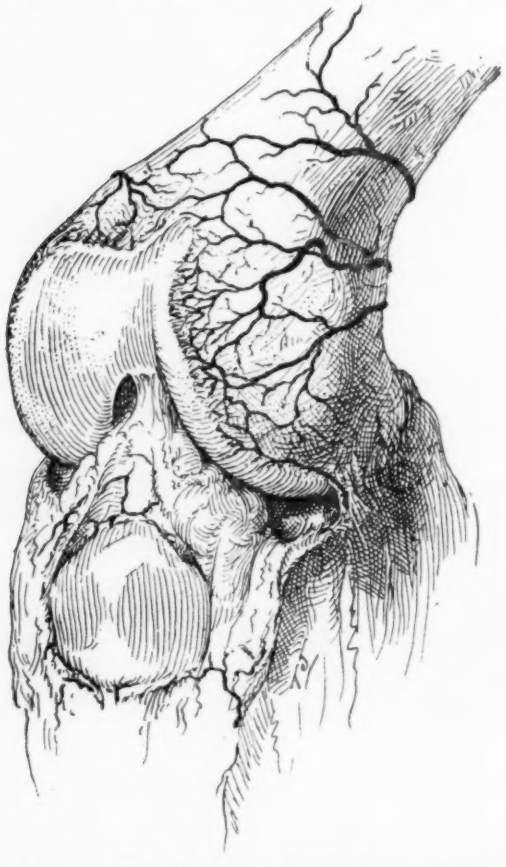
No. 3. Photomicrographs of cross sections 100 mcr. thick of the head of the humerus. A few of every tenth serial section are represented.

The arteria circumflexa humeri anterior sends branches to the biceps tendon which accompany the tendon into the joint, ramify there, and enter the bone in and about the sulcus bicipitis humeri. From there they send many fine ramifications to the articular surface of the humeral head. Figures 2 and 3 illustrate this peculiar arrangement of the blood capillaries of the head of the humerus.

The Knee. Tuberculosis of the knee comprises 15% of all tuberculous affections of bone and joints, and 33% of all the tuberculous gonitis we meet with in children under the age of ten years. This fact strengthens

our belief that to study the rôle of the vascular system in tuberculosis of bone it is necessary to study the circulation in young individuals.

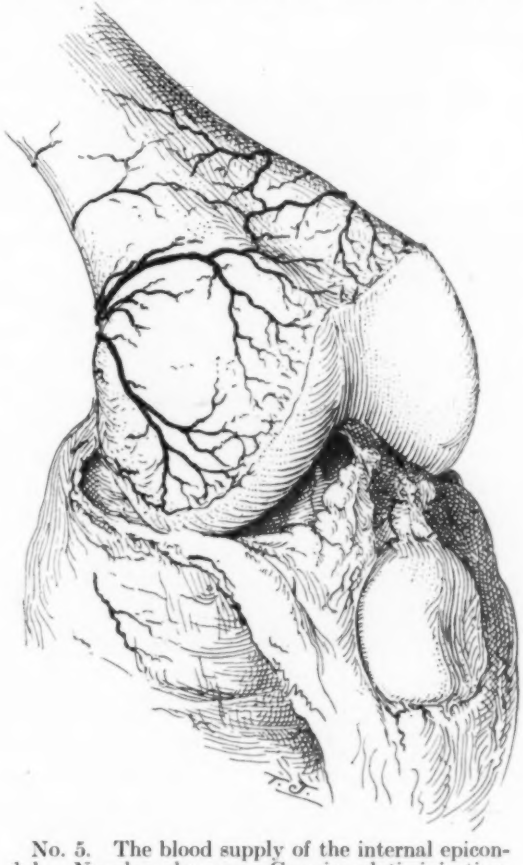
The primary foci in tuberculous gonitis in children are located in the epiphyses of the femur in 59%; in the epiphyses of the tibia in 34%, and



No. 4. The blood supply of the external epicondyle. New-born human. Carmin-gelatin injection. The vessels of the intercondyloid notch are not shown.

in the patella in 7%. Our study of the rôle of the vascular system in localization of the primary foci in tuberculous gonitis we confined to the study of the blood supply of the distal end of the femur. Koenig in one of his first classical monographs on tuberculosis of bone and

joints,* pointed out the interesting fact that in the knee joint a tuberculous involvement is liable to remain circumscribed and localized for a long time, not involving the rest of the joint and not spreading farther into the bone. Here in tuberculosis of the knee we cannot be too careful in deciding



No. 5. The blood supply of the internal epicondyle. New-born human. Carmin-gelatin injection.

whether a bone lesion is a sign of a primary focus of osseous tuberculosis or is a granulating lesion secondary to synovial tuberculosis. If we take into account the unquestionable primary lesions of osseous tuberculosis, we find that the lateral epicondyle of the femur is the most frequent seat of the primary focus, the next in frequency being the medial epicondyle,

* Die Tuberkulose der Knochen und Gelenke. Fr. Koenig, Berlin, 1884, p. 138.

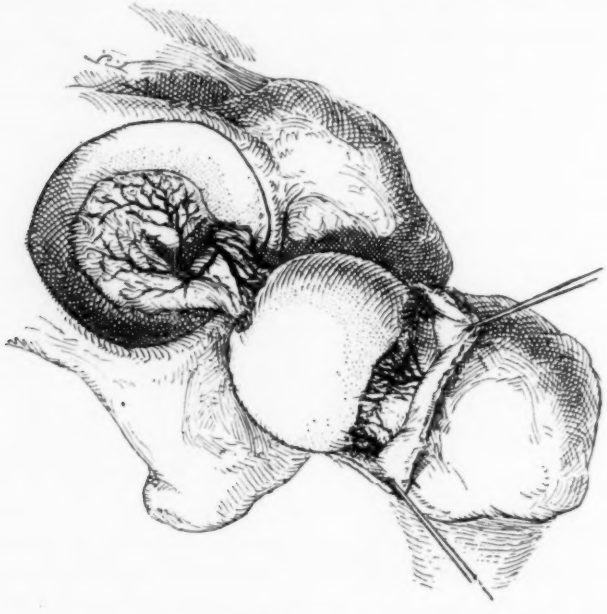
and lastly the intercondyloid notch. Figures 4 and 5 are drawings made from human newborn after injection of the arteries and capillaries with carmin-gelatin one hour after death. Figures 4, 5, and 6 demonstrate well the parallelism between the frequency with which certain regions of the distal end of the femur are primarily involved in tuberculosis and the richness of their respective blood supply.

No. 6. Photomicrographs of two sagittal sections 200 mcr. thick through the epicondyli femoris: On the top—section through the external epicondyle; on the bottom—through the internal epicondyle. Each section is equally distant from the tangential plane of the respective epicondyle.

The Hip. The great clinical importance of tuberculosis of the hip we see from the fact that 79% of all inflammatory conditions of the hip are tuberculous. The hip joint tuberculosis comprises about 31.4% of all tuberculous involvements of bones and joints. The importance of studying material of young individuals for the determination of the rôle which the blood supply plays in localization of the primary foci we see

again here. It is a known fact that tuberculous involvements of the hip joint are osseous (primarily) in children and synovial (primarily) in adults. This fact is readily explainable if we remember that while the blood vessels of the bones participating in formation of the hip joint are end-vessels in children, they anastomose widely in adults. The question of the localization of the primary focus in osseous hip tuberculosis is still an unanswered one. The extraordinary physiological importance of the hip joint, together with the rather difficult surgical approach to it, largely contributes to the fact that in the majority of cases coming to operation or necropsy the pathologic process is too far advanced to enable us to determine the seat of the primary focus. However, from the rather mediocre material which came for operation in an early stage we can draw certain conclusions as to the localization. If we will take this material as 100%, we will have the primary focus in the acetabulum as 57%, in the caput femoris as 25%, and in the collum femoris as 18%. In the acetabulum the primary focus is usually found in the middle of the Y-shaped cartilage. Later in life the Y-shaped cartilage disappears and is replaced by the union of the bones forming the pelvis. Here in the lower anterior quadrant of the acetabulum we have the fossa acetabuli, a 3-4 mm. wide area, where the bone is free from cartilage. This area is usually covered with abundant fat tissue forming the pulvinar acetabuli and giving rise to the ligamentum teres femoris. This is the most frequent seat of the primary focus in synovial tuberculosis. It is interesting to note that the most frequent seat of the primary focus in osseous, as well as in synovial tuberculosis of the acetabulum, is practically the same. This peculiarity is readily explained anatomically as it is seen from Figure 7, showing the abundant blood supply of this area of the acetabulum. The multitude of capillaries seen here are end branches of the arteria acetabuli of the ramus posterior arteriae obturatoriae. This artery also contributes the blood vessels running in the ligamentum teres femoris. The caput femoris, as we mentioned above, is the seat of the primary focus in about 25% of all cases. There has been done but little work in the further distinction of the different regions of the head of the femur in relation to the seat of the primary focus. It has been noticed, however, by clinicians of wide experience that the "Schenkelhalsspitze"—lower angle of the femoral head—is the locus minoris resistentiae in tuberculous involvement. This has been emphasized to me by Dr. Steindler, who thinks that a beginning atrophy of the "Schenkelhalsspitze" should always be considered as an incipient indication of a tuberculous involvement. Our anatomic studies of the blood supply of the femoral head brought to us

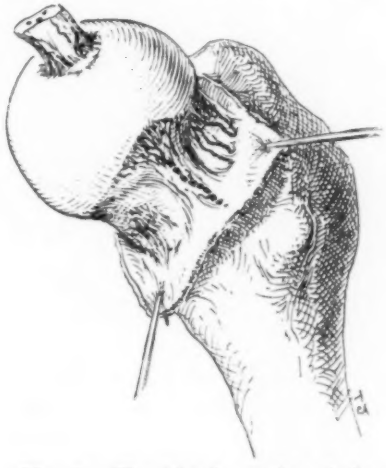
the anatomic basis for these clinical facts. The question of the blood supply of the femoral head has always been a disputed one, and the fact that such authorities as Hyrtl, Luschka, Langer, and Henle could not agree on the question of the importance of this or other blood vessels for the nutrition of the femoral head is very instructive, in so far as it demonstrates once more the wide-spread mistake of drawing general conclusions



No. 7. The blood supply of the acetabulum and the femoral head (posterior and superior aspect). Red lead injection. New-born human.

from inadequate anatomic material. The conclusions as to the importance of the ligamentum teres femoris for the blood supply of the femoral head will depend entirely upon the kind of material studied, whether it be adult or child. We shall not discuss here all the contradictory opinions of the authorities mentioned above and we will turn to the results of our own studies. The head of the femur in young individuals is supplied with blood vessels approaching the head in three main regions. One bunch of vessels comes from the subtrochanteric fossa, runs along the superior aspect of the neck of the femur and enters the head at the upper quadrant of the articular surface of the head. This group of vessels has

been emphasized by Lexer as the most important for the nutrition of the head. We believe that the bundle of vessels which runs along the lower aspect of the neck and enters the head at the "Schenkelhalsspitze" is of far greater importance for the nutrition of the head and consequently also plays a greater rôle in the localization of the primary focus in tuberculous involvement. This belief is based on the anatomic facts of the blood supply of the head, illustrated in the Figures 7, 8 and 9. It is especially convincing in a study of a wax reconstruction model of the upper end of the femur of a new-born child. This view is also well supported embryologically, since the lower angle of the head of the femur—



No. 8. The blood supply of the femoral head (anterior and inferior aspect.)

the "Schenkelhalsspitze"—morphologically belongs to the neck of the femur, so that the epiphyseal junction line usually so abundantly supplied with blood vessels penetrates this portion of the head. The third group of vessels consists of the arteries carried to the head by the ligamentum teres femoris. They play a certain limited rôle in the nutrition of that portion of the head which surrounds the fovea capitis in young individuals, and are of no importance whatsoever in the adult. The relative rarity of primary foci in the femoral neck (near the epiphyseal line) we believe is due to the fact that not all of the end branches of the diaphyseal blood vessels stop at the epiphyseal line and do not participate in the nutrition of the head proper in young individuals, as it is claimed by Lexer. In

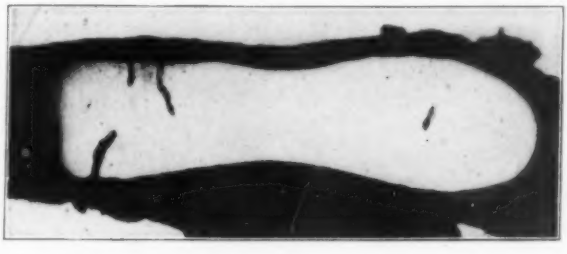
examining new-born material we met numerous cases where the diaphyseal branches crossed the epiphyseal line on their way to the femoral head.

These results of our anatomic study of the blood supply of the skeletal portions forming the hip demonstrate well the parallelism between the frequency with which certain skeletal regions of the hip joint are primarily involved in tuberculosis with the abundancy of their blood supply.

No. 9. The blood supply of the femoral head and neck. Skiagram (enlarged four diameters) of a femur of a new-born injected with red lead. Note the complete rete of capillaries of the "Schenkelhalsspitze."

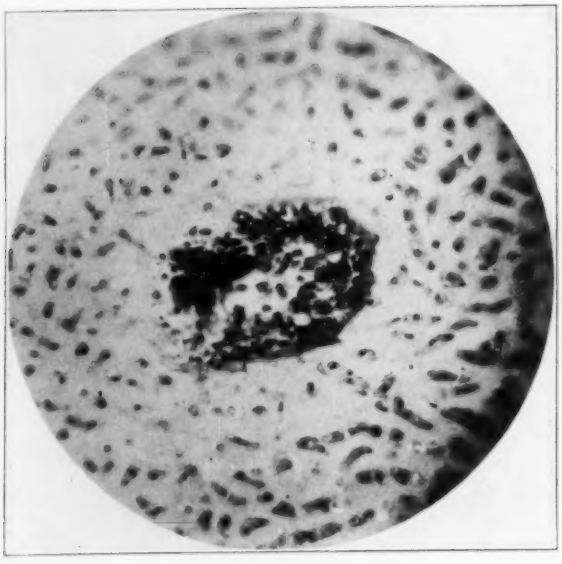
The Costal Cartilage. Tuberculous involvements of the ribs are more frequent than those of the sternum. In cases of tuberculous involvements of the skeleton of the chest we find five on the ribs to one on the sternum. The anterior part of the rib is more frequently involved than the lateral, and the latter more frequently than the posterior. Usually the foci on the ribs are located at the points where the bone meets the cartilage, the

chondrosternal foci being the most frequent. However, it is a well known fact that there are also independent foci in the costal cartilage beneath the perichondrium as well as in the deep portions of the cartilage. Since the costal cartilage has always been considered as lacking any blood channels, it is usually believed that the foci found in the costal cartilages are not primary, but are extensions of a process from the perichondrium or from the bony portion of the rib. As a matter of fact, Koenig and Krause claimed that there is no primary involvement of costal cartilage. Of the same opinion are all the authorities, who base their belief on the generally accepted descriptions in the leading textbooks on anatomy and histology,

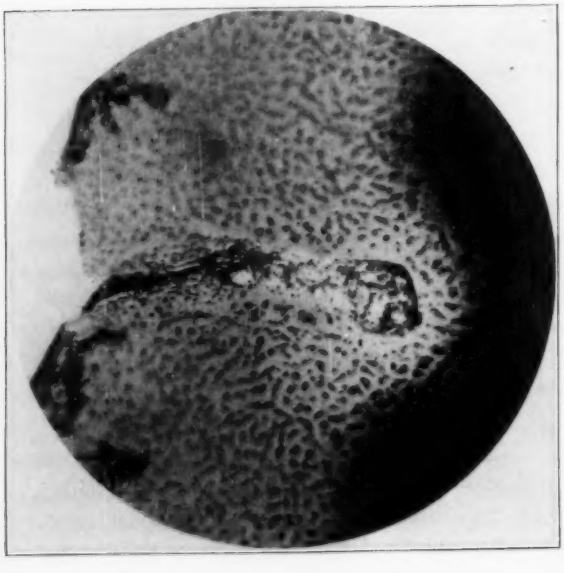


No. 10. Photomicrograph of a section 200 mcr. thick of a costal cartilage of a new-born human injected with India ink-gelatin.

that costal cartilage is lacking blood vessels. Authors who, like Lampe, studied the blood supply of the ribs in further detail, claim that small blood channels appear in the costal cartilage in later life, in the third decade. The very frequent occurrence of metastatic inflammatory foci in the costal cartilage after typhus exanthematicus observed by the writer in individuals before the age of twenty in Russia during the recent World War led him to suspect that there are definite blood channels supplying the costal cartilages. We studied this question in detail in costal cartilages of human new-born. An injection through the left ventricle under considerable pressure with carmin-gelatin and India ink-gelatin with subsequent hardening in formalin revealed in the costal cartilages channels filled with the injecting mass, which seemed to be in communication with the blood vessels of the perichondrium. Serial sectioning and microscopic study of costal cartilages of new-born human beings proved these channels to be typical blood capillaries. (See Figures 10, 11 and 12.) That such budding dilatations and blind endings of the blood channels present favorable conditions for a retention of tubercle bacilli brought in by the blood stream is self-evident.



No. 12. Photomierograph of a section of costal cartilage, showing a cross section of a blood vessel. Magnification 230 diameters.



No. 11. Photomierograph of a section 10 mcr. thick of costal cartilage of new-born human. Note the longitudinal section of a blood capillary. Magnification 100 diameters.

DISCUSSION

We believe that the anatomic facts—the result of our investigation in relation to the most frequently involved skeletal regions in tuberculosis—speak in a simple and positive way for the embolic theory of the pathogenesis of bone tuberculosis. When the blood supply is richer, other features being equal, there is a greater possibility of tuberculous involvement and hence the primary focus in these regions is more frequent. We say "*other features being equal*," because we do not mean to claim that such factors as trauma, injury, strain, do not play any rôle in the localization of the primary focus. There has been much written and said pro and contra about the rôle of trauma, injury, and physical strain as an etiologic factor in bone tuberculosis. We believe this question to be far more simple and clear than it could be judged from the abundant contradictory literature. As a rule, trauma plays a certain definite rôle as an etiologic factor in all pathologic conditions of the animal body. Why, then, expect an exception in case of tuberculosis of bone, where the rôle of the so-called "lowering of resistance" has never been seriously questioned? That constant strain and stress, even of a physiologic nature, has something to do as an etiologic factor in bone tuberculosis, we easily notice from the statistics compiled by us from the literature* comprising about 35,000 cases of bone and joint tuberculosis:

Region affected	*Per cent*
Spine	39.1
Hip	31.4
Knee	15.0
Ankle	7.2
Wrist	1.7

It is evident that tuberculosis most frequently affects those parts of the skeleton which are especially adapted to the function of support and locomotion of the body, and which are under almost permanent physiological strain.

The results of our study, which we believe add another stone to the foundation of the hematogenous embolic theory of bone tuberculosis, are of importance yet for other reasons. There has always been some opposition to the embolic theory of bone tuberculosis. It is interesting to note that this opposition was raised exclusively by pathologic anatomists.

* The statistics are compiled from Alfer, Billroth, Jaffe, Cheyne, Koenig, Volkmann, Krause, Menzel, Lanelogue, Gangolphe, Schmalfuss, Oelhecker, Waldstrom, Boston Children's Hospital, New York Hospital for Ruptured and Crippled.

Orth and, later, several of his pupils were the opponents to this conception of the pathogenesis of bone tuberculosis. This opposition, however, was forgotten in the course of time. Recently opposition to the embolic theory was raised in this country by Dr. Leonard Ely. The latter suggests a theory of pathogenesis of bone tuberculosis based on the known specific affinity of tubercle bacilli for epithelial, endothelial, and lymphoid tissue (red bone marrow of the epiphyses, synovia of the joints). This theory is supposed to answer the main question: Why are primary foci of tuberculosis of bone found in the epiphyses while in suppurative osteomyelitis the shaft is involved? We shall refrain from a detailed discussion of Ely's theory, and we will just point out a few anatomic and clinical facts which are of great importance as far as Ely's arguments are concerned. About twenty years ago Friedlaender pointed out that the general opinion that primary tuberculous foci of bone are found exclusively in and about the joints is contrary to clinical facts. He described three types of diaphyseal bone tuberculosis: (1) *Solitary metaphyseal focus* identical with an epiphyseal focus on the other side of the epiphyseal line. (2) *The infiltrative focus from the medullary cavity*, and (3) the *periosteal focus*. The existence of a pure periosteal form of diaphyseal tuberculosis is questionable (J. Fraser), but the two other types of diaphyseal tuberculosis are sufficient to remind one that tuberculous osteomyelitis can and does localize, though seldom in regions where red bone marrow is not found. Oelhecker recently expressed the same opinion as to the occurrence of diaphyseal bone tuberculosis. There is yet another type of tuberculosis of the skeleton which is in direct opposition to Ely's theory—tuberculosis of costal cartilage. In costal cartilage of the young we do not find any marrow elements, either red or yellow, although primary foci are known.

CONCLUSIONS

The parallelism between the frequency with which certain skeletal regions are involved in tuberculosis and the abundance of their blood supply supports greatly the embolic theory of the pathogenesis of bone tuberculosis.

The vascularization of the costal cartilages proves that tuberculous foci in these regions are often of primary and not secondary nature.

The anatomic, as well as clinical facts, are in perfect accord with the embolic theory. They speak against the criticism of this theory and against the suggested substitute theories.

LITERATURE QUOTED

VON VOLKMANN, RICHARD: Sammlung klinischer Vortraege, Leipzig, 1870–1890.

KOENIG, FR.: Die Tuberkulose der Knochen und Gelenke. Berlin, 1884.

KOENIG, FR.: Spezielle Tuberkulose der Knochen und Gelenke. 1896–1902. Berlin.

KRAUSE, FEDOR: Die Tuberkulose der Knochen und Gelenke. Leipzig, 1891.

SENN, NICHOLAS: Tuberculosis of bone and joints. Philadelphia, 1892.

MUELLER, W.: Experimentelle Untersuchungen ueber die Entstehung der tuberkuloesen Knochenherde. Deutsch. Ztschr. f. Chir., 1887, p. 37.

LEXER, ERICH: Untersuchungen ueber Knochenarterien mittelst Roentgen Aufnahmen injizierter Knochen und ihre Bedeutung fuer einzelne pathologische Vorgaenge am Knochensysteme. Berlin, 1904.

FICK, RUDOLPH: Die Mechanik der Gelenke, Band 1 des "Handbuch der Anatomie des Menschen." Bardeleben. Jena, 1907.

LAMPE, RICHARD: Ueber die Entzuendung der Rippenknorpel nach Typhus abdominalis. Deutsch. Ztsch. f. Chir., 1899, p. 603.

ORTH, J.: Festschrift zur Ehre seines Vaters von J. Orth. Berlin, 1887, p. 24–25.

ELY, L. W.: Diseases of Bones and Joints. Surgery Publishing Company, New York, 1914.

FRASER, J.: Tuberculosis of the Bones and Joints in Children. London, 1914.

FRASER, J.: The Etiology and Pathology of Bone and Joint Tuberculosis. Jour. Amer. Med. Ass'n, Vol. 64, 1915, p. 17–24.

FRIEDLAENDER: Quoted from the discussion by Steindler of Fraser's paper mentioned above.

OELHECKER, F.: Tuberkulose der Knochen und Gelenke. Berlin, 1924, p. 5.

PSEUDOCOXALGIA

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Legg, in 1909, was the first to give a description of pseudocoxalgia and to isolate it as a definite clinical entity. He described five cases, and in each regarded trauma as the etiologic factor. In 1910 Calvé separated ten cases from five hundred cases of coxalgia, and as he found rachitic manifestations more or less marked in all, he was inclined to believe that rickets played a considerable rôle in the etiology. Almost simultaneously Sourdat discussed a small series of cases of "pseudocoxalgia," giving an accurate description of their radiologic appearance. Perthes, whose name appears to be most intimately associated with this disease, in 1913 published an extensive clinical and radiologic description of the condition, as well as a pathologic report on a portion of the head of the femur removed by operation. He clearly differentiated this disease from arthritis deformans juvenilis, and called it "osteochondritis deformans juvenilis."

During the last ten years remarkable progress has been made in the investigation of this subject. The complete cycle of changes in the head of the femur has been worked out, and the end-results have been closely observed. Various surgeons have described important pathologic findings, observed similar processes in other epiphyses in the body, and studied their significance. Most surgeons are in agreement with regard to the symptoms, diagnosis, and treatment, but the etiology still remains an unsolved problem.

ANALYSIS OF CASES

Authors do not agree concerning the incidence of the disease. Some have compared it with tuberculosis of the hip only, others with miscellaneous lesions of the hip. Gauvain noted twelve cases in a series of two hundred and fifty-one cases of alleged tuberculosis of the hip, and Calvé ten in five hundred similar cases. Sorrell found six in one thousand five hundred miscellaneous lesions of the hip, and Delitala four in one thousand such cases. The disease is, therefore, by no means rare. No attempt has been made in this series to estimate the relative frequency of the condition. The disease is generally unilateral, but in a certain proportion of cases it

is bilateral. In the series of fifty-six patients with pseudocoxalgia observed in the Mayo Clinic during the last ten years, the condition was unilateral in forty-six and bilateral in ten. In the bilateral cases one side had been diseased for considerable time before the other side. The opposite side, like the first, became involved insidiously, and often was noted only on radiologic examination.

Males predominated in the series: forty-six of the patients were boys and ten girls. This predominance of the male sex is distinctly in favor of the traumatic hypothesis of the origin of the disease, boys being more exposed to trauma than girls. This hypothesis is favored still more by the fact that the male sex predominates in the bilateral cases; in the ten cases of the series, nine of the patients were boys and one a girl. Two members of one family, and father and son in another, have been noted; from that it has been suggested by some authors that the disease was of a familial and hereditary character, but this finding appears to have been purely incidental.

Leukocytosis. In thirty-six of the fifty-six cases a leukocyte count was taken; in only one case was there leukocytosis, the count being twenty thousand; in the others the count varied from five thousand three hundred to eleven thousand six hundred. This absence of leukocytosis is rather against the possibility of an infective agent having a bearing on the etiology of this disease; in the one case of leukocytosis it was probably due to some incidental disease.

Temperature. As none of these patients was treated as a hospital case, no continuous temperature records of any case were taken, but in forty-seven of the fifty-six cases the temperature was recorded at the Clinic; in nineteen the temperature ranged from 99° to 100°. A slight rise of temperature in 40 per cent. of the cases does not justify drawing any conclusions as to the infective hypothesis of this disease. No single instance of a high temperature was recorded.

Laboratory and Clinical Tests. The von Pirquet test was made in fifteen cases; ten of the tests were negative, two positive, and three partially positive. The Wassermann test, made in twenty-eight cases, was negative in all. The results of these tests exclude a tuberculous or syphilitic origin of the disease.

Trauma. Seventeen of the fifty-six patients gave a definite history of trauma at, or about, the time of onset of the disease. In tuberculosis of the hip the statistics given by various clinicians vary from 7 to 49 per cent.; in the lower percentages only those cases in which trauma was clearly established are included. In the higher percentages, the trauma

appears to be less definite. Legg, in his original description of the disease, considered trauma as the most important etiologic factor. Many cases are recorded after operative trauma, as may occur in reduction of congenital dislocation of the hip.

Previous Illnesses. The illnesses previous to pseudocoxalgia are merely those of childhood. Many of the patients had had sore throat repeatedly, and a number had had enlarged tonsils with plugs in the crypts; tonsillectomy was advised in these cases.

Age Incidence. Practically all of the cases occurred in the second half of the first decade of life. The youngest patient coming for treatment was four and one-half years of age, but the earliest onset was at two years. On the other hand, the maximum age was variable; many patients were seen in adult life, who came because of the superimposition of osteo-arthritis.

ANATOMIC CONSIDERATIONS OF THE HIP-JOINT

A study of the normal hip in children helps to reveal the cause of this disease, the position of the epiphysis at various periods of childhood and its vascular supply being especially emphasized. The epiphysis of the head of the femur during the age period of Perthes' disease, or the second half of the first decade, is roughly horizontal, and any trauma occurring at this age is not so likely to cause a displacement of the epiphysis as it is later in life, when the epiphyseal line becomes oblique. Coxa vara is then the more common lesion. A study of the vascular supply of the head of the femur also appears to throw some light on the pathologic changes occurring in pseudocoxalgia. This work was first carried out by Lexer, and later by Waldenstroem. Lexer, in 1903, injected mercury and oil of turpentine into the smaller arteries of the bones in children, and took stereoscopic roentgenograms, in working out the vascular supply of the head of the femur. The site of the vessels appears to be as follows:

1. The nutrient artery passes obliquely through the bone near the center of the shaft, and divides into two main branches, one running to each end of the bone. The artery gradually takes up a central position in the marrow. The primary branches as they approach the cancellated ends of the bones usually divide into two or more smaller branches.

2. A group of vessels at the epiphysis come in from all sides, part going to the epiphysis and part to the diaphysis, chiefly from the external and internal circumflex arteries and the vessel in the ligamentum teres. The vessel in the ligamentum teres is a variable one, and does not appear to function after the age of four or five years. This ligament is the modified

tendon of the pectineus muscle and is in process of evolution, and, like all evolutionary structures, it shows much variation. The distribution of the epiphyseal vessels is circular: coming up from the diaphyseal region and turning into the epiphysis in such a fashion as to surround the epiphyseal line like a calyx, many of these vessels interlace across the epiphyseal line.

3. A group of fine vessels lying in the periosteum covering the outer surface of the bone run through all parts of the compact bone in the haversian canals through to the spongy part.

Throughout the cycle of changes in this disease, the articular cartilage of the head of the femur appears to remain intact, a point distinctly favoring the belief that the synovial fluid furnishes its nourishment, as suggested by Strangeways.

CLINICAL MANIFESTATIONS

The onset of the disease is almost invariably insidious; the patient may have a limp for years before consulting a physician. The limp is the earliest symptom, and as a rule is not associated with pain, but occasionally pain is referred both to the hip and the knee; less frequently still a clicking sensation in the hip is complained of. A certain small proportion of patients have acute phases from time to time, characterized by a temporary increase in the muscle spasm and pain on motion of the hip, very often necessitating their remaining in bed for a few days or even a week or more.

There is limitation of motion due to a reflex protective mechanism. This limitation is generally in abduction and internal rotation, but often the protective mechanism is more marked, and motion in all directions is limited; although the movements are limited by muscle spasm, there is little or no pain when further passive motion is attempted. This protective mechanism, although a rigid one, is painless. In the early stages the rigidity disappears under anesthesia, but in the later stages, even under anesthesia, there is limitation of abduction and rotation due to a real shortening of the adductor and external rotator muscles. The muscle spasm is probably the primary cause of the deformity of the head of the femur, for persistence of muscle spasm during a period of disturbed ossification must lead to permanent alterations in the head and neck of the femur. As the disease progresses, a slight degree of real shortening gradually appears, amounting to an average of 1 cm., but in some cases as much as 2 cm. Associated with this real shortening, minor degrees of flexion and adduction deformity occur. Another feature associated with

the real shortening is the elevation of the great trochanter above Nélaton's line, and at the same time the great trochanter appears broader than normal.

Atrophy of the gluteal, thigh, and calf muscles is invariably present in a minor degree; it is never as extensive as in tuberculosis of the hip. This wasting of the gluteal muscles is responsible for the positive Trendelenburg's sign so common in this disease. As the head of the femur enlarges in the later phases it becomes very prominent in Scarpa's triangle. There is an entire absence of constitutional signs, as evidenced by the absence of both fever and leukocytosis. The active phases of this disease last a few years, after which a slow moulding of the head takes place until full growth is attained.

The course of this disease falls into several definite stages with distinct clinical manifestations and radiologic appearances: (1) the initial stage, lasting for six months; (2) the fragmentation stage, lasting from one to two years; (3) recalcification and regeneration, lasting from two to five years; (4) moulding of the completed head, which goes on until the age of twenty-one years; and (5) osteo-arthritic changes of adult life, beginning at the age of thirty years.

The Initial Stage. This stage lasts about six months, and is characterized by the disc-like appearance of the head in the roentgenograms. This period is often practically symptomless, although the roentgenologic appearances are quite distinctive. The epiphyseal nucleus appears shrunken and as if more concentrated than normal; it becomes denser and more opaque to the X-rays. The articular cartilage is normal in height and appearance, and there are no changes in the neck of the femur or acetabulum. This stage is not often seen, as the symptoms are slight and patients are not often brought for treatment during this phase.

The Fragmentation Stage. This stage lasts from one to two years, and it is during this phase that the patients are usually brought for treatment. The disc-like nucleus of the previous stage breaks up, usually into three pieces, sometimes more, but seldom fewer. The cartilage of the head sinks lower and lower, with elevations and hollows corresponding to the fragments of the head. The roof of the acetabulum becomes slightly modified; instead of being horizontal, it becomes oblique, with an angle of approximately 45°. The head becomes slightly displaced upwards and outwards. The epiphyseal line is irregular and broken at one or more points, and clear zones appear in the neck just below the epiphysis. The neck slowly becomes thicker, producing an apparent coxa vara, but the angle of inclination is not changed, so that the coxa vara is only apparent, and is due to a thickening on the under surface of the neck.

There is an articular reaction and effusion into the joint. In this stage the symptoms are most marked, the acute phases occur, and protection is usually required.

Recalcification and Regeneration. This stage lasts from two to five years. The head begins to regenerate slowly, and the lime salts return to it. More and more of the head lies out of the socket, becoming flattened and enlarged, and the neck slowly thickens. The clear zones in the neck disappear. The symptoms are less marked and protection is not so necessary.

The Moulding of the Completed Head. Although the head is completely regenerated, a gradual moulding goes on until adult life is attained. The head appears telescoped into, or flattened against, the great trochanter. Two types of head are the result: the ball-shaped, in which the head is roughly half a sphere, and the oval, which is like half an egg in shape. The functional results differ somewhat in the two types, although in both the pathologic process seems in excess of the symptoms. In the ball-shaped head, the functional results are better than in the oval head; the limp, the shortening, and the limitation of motion are all slight; whereas in the oval head the symptoms are all more marked, but many patients with this disability fought in the great European War. A considerable portion of the head lies outside the acetabulum and can be felt much enlarged in Scarpa's triangle.

The osteo-arthritic changes of adult life generally start at the age of thirty years. From twenty-one to thirty years of age, the patient's condition usually remains stationary.

ALLIED DISEASES

There are several diseases in other parts of the skeleton which cause changes similar to those of pseudocoxalgia: (1) osteochondritis of the spine (Scheuermann); (2) tarsal scaphoiditis (Köhler); (3) osteochondritis of the heads of the second and third metatarsals; and (4) Schlatter's disease.

Osteochondritis of the spine presents the characteristic deformity of kypho-lordosis, and occurs slightly later in life than pseudocoxalgia, and much more commonly in boys than in girls. It generally commences between the ages of twelve and sixteen years, when the growing youth has started hard physical work. The deformity develops slowly, with little or no pain or discomfort. Roentgenograms reveal an irregularity and fragmentation, particularly of the epiphysis of the lower dorsal vertebrae. These vertebrae slowly assume a wedge-shaped appearance, and the characteristic deformity results.

Tarsal Scaphoiditis. Many cases of this disease have been recorded, and the pathologic anatomy, recently described from a surgical case by Lecène and Mouchet, is identical with that of pseudocoxalgia. The disease runs its course and usually ends in complete restitution, in this way bearing a close resemblance to pseudocoxalgia.

Osteochondritis of the Second and Third Metatarsals. Here again trauma appears to be a factor. Heitzmann has described the gross and microscopic pathology of two cases. They presented appearances identical with that of pseudocoxalgia, but on a smaller scale, the essential point being the cutting off of the vascular supply, with necrosis of the epiphysis.

Schlatter's Disease. This disease also has features in common with all these conditions.

The occurrence of these similar diseases in various sites in the body again favors the hypothesis that trauma is a factor in the production of pseudocoxalgia. Abscess formation has never occurred in any of these various sites. The affection of several vertebrae in the spine and its occurrence in the growing adolescent suggests congenital weakness as well as trauma, as etiologic factors.

PATHOLOGY

The material for the study of the pathologic process was obtained not only at operation, but also from one or two specimens removed at postmortem examination of patients who had died from some intercurrent disease.

Legg operated in one of the cases in his original series. Since then Perthes, Kidner, Riedel, Vignard, Phemister, McWhorter, Osgood, and Heitzmann, all have recorded one or more cases. The operations have been performed with different objects in view: some in order to find out the true nature of the disease, others in order to increase the range of abduction, and still others in order to hasten the process and cut short the cycle of events.

In the synovial cavity there is generally more or less slightly turbid and straw-colored fluid. The synovial membrane itself may be thickened, showing a mild synovitis with tags. The head of the femur is flattened, but the cartilage covering it is generally normal in color, smooth, and indented near its middle. The head bulges beyond the acetabular margins. On section, the head of the femur is seen to be broken up, usually into three fragments, the cartilage covering the head being thrown into three elevations, with intervening furrows. This flattening and fragmentation causes the upward and outward displacement of the head of the femur.

Necrotic areas extend from the inner part of the head through the epiphyseal line into the upper part of the neck, and frequently carry portions of the epiphysis with them. These necrotic areas contain granulation tissue and necrotic débris, in which are usually embedded several small sequestra. Bridges and aberrant islands of cartilage extend from the epiphyseal line to this cartilage, covering the head; these latter appear to be new formations and do not come from the epiphyseal line. The neck is thickened, as if it had been compressed or telescoped into the great trochanter.

Bacteriology. Cultures and guinea-pig inoculations from the synovial fluid and from the contents of the necrotic areas were negative, but Kidner, Legg, and McWhorter have each cultivated one colony of staphylococci from the contents of these necrotic areas, but as they obtained only one colony in each case, these were probably contaminations.

The sequence of events has been well tabulated by Heitzmann as follows: (1) vessel blockage; (2) primary necrosis of the epiphysis; (3) the formation of granulation tissue which breaks the epiphysis into three or more parts; (4) the formation of ridges in the cartilage lining the joint; and (5) the formation by processes, passing through the epiphysis, of cystic cavities containing sequestra beneath the epiphyseal line.

HYPOTHESES WITH REGARD TO CAUSATION

Three hypotheses have been advanced with regard to the causation of this disease: (1) congenital; (2) infectious; and (3) traumatic.

The Congenital Hypothesis. Calot believes that pseudocoxalgia is a malformation not only of the head of the femur, but of the entire hip-joint, the changes in the acetabulum playing a considerable part. The points brought out by Calot are: (1) it is bilateral, although one side is often clinically silent and histologically and bacteriologically negative; (2) normally the roof of the acetabulum is nearly horizontal; in this disease it forms an angle of 45°; (3) the head of the femur is normally like a half orange; in this disease like a half lemon; (4) the fitting is imperfect, and the head of the femur is displaced upwards and outwards. The imperfect fitting produces the changes of osteochondritis, secondary to the original malformation.

Jansen has brought forward a congenital hypothesis with many points of similarity to that of Calot. He points out that the malformation involves the whole hip-joint, the acetabulum regularly showing characteristic changes. The socket for the head of the femur is too shallow and

too wide, due to the fact that the ischium is swung medially over a few degrees; the ischial part of the acetabulum goes with it, producing an ischium varum. These changes alter the mechanical conditions, and changes in the head and neck of the femur are the natural result. The stresses and strain to the head of the femur are transmitted through a small area; as a result, lime salts are absorbed from the head and it becomes plastic. It is highly probable that the changes in the acetabulum are really secondary to this deformation of the head.

The Infectious Hypothesis. Many regard this disease as due to a subepiphyseal, hematogenous infection of a low grade of virulence, but this hypothesis has little to support it. Staphylococci have been grown from the necrotic areas by Kidner, Legg, and McWhorter, but only in very small numbers,—so small that it seems highly probable that these were due merely to contamination. In a number of cases the tonsils have been enlarged, with infection of the crypts, and in others, there has been a chronic infection of the middle ear, which may have been the primary source of infection. If it is a blood-borne infection, the area supplied by the blood vessel should be the only part of the head involved, not the whole head, as is invariably the case. The absence of temperature and leukocytosis and the fact that the disease never proceeds to abscess formation also oppose this hypothesis.

The Traumatic Hypothesis. This hypothesis seems to have more support than the others, the great predominance in boys as compared with girls, and still more the predominance of the bilateral cases in boys being the strongest arguments. There was a definite history of trauma in seventeen of the fifty-six cases at, or about, the time of onset of the disease. Many cases develop after the trauma caused by the reduction of a congenital dislocation of the hip. There is no acute onset or evidence of constitutional disturbances.

CONCLUSIONS AS TO ETIOLOGY

No one of the foregoing hypotheses seems adequate to explain the etiology in all cases, and it seems highly probable that two of the factors may be involved; inherent congenital weakness at the epiphyseal line, and trauma.

The disease has much in common with adolescent coxa vara, although the age period and the position of the epiphysis, and consequently the deformity, are different. There appears to be a definite inherent weakness at the epiphyseal line, whereby trauma of a minor nature, not sufficient to cause displacement, but sufficient to cause vessel blockage to the

FIG. 1

Initial stage of pseudocoxalgia. Symptoms have existed for six months. Concentration and increase in density of the epiphysis is shown.

FIG. 2

Stage of fragmentation. Symptoms have existed for two years. The epiphysis is shown breaking up into three pieces; thickening of the neck and clear zones appear just below the epiphyseal line.

epiphyseal line, may produce the subsequent changes. Its location bilaterally in the hip, and its occurrence, particularly in the spine, favor this last view.

TREATMENT

In the treatment of pseudocoxalgia we have two objects in view: (1) to relieve pressure in the deforming and softened head; and (2) to improve the muscle tone. Various methods of relieving the pressure have been advocated, some more effective than others; for example, (1)

FIG. 3

Stage of recalcification and regeneration. Symptoms have existed for three years. The head is being reformed and is shown spreading toward the great trochanter. Clear zones in the upper part of the neck are disappearing.

crutches to take a portion of the weight off the hip; (2) crutches and also a plaster-of-Paris spica cast with a high shoe on the sound side; and (3) the walking caliper, which at the same time maintains motion in the hip-joint. The disadvantages of these methods are that they increase the muscle atrophy, which in turn produces a greater limp and a more marked Trendelenburg sign, the gluteal muscles appearing to suffer most. Massage

FIG. 4

The stage of the completed head undergoing moulding. Symptoms have existed for five years. The rounded type of head is shown.

FIG. 5

Stage of the completed head undergoing moulding. Symptoms have existed for seven years. Oval type of head with more marked symptoms than in the case illustrated in Fig. 4.

and muscle training keep up the muscle tone and do not appear to increase the shortening; this treatment alone is advocated by many.

Several types of operative treatment, from removal of the rarefied focus to arthrodesis of the hip, have been carried out, but it is doubtful whether any type of operative procedure is justifiable. Fixation cannot be maintained through all the phases of the disease. Treatment is most

FIG. 6

Osteochondritis of the lower dorsal spine.

necessary during fragmentation, and the time limit would be six months. Sundt compared two series of cases, one treated and one not treated, and found no appreciable difference in the ultimate results. The most satisfactory treatment appears to be fixation in a spica cast in slight abduction for six months, followed by massage and muscle training.

CONCLUSIONS

1. Trauma is undoubtedly instrumental in the causation of pseudocoxalgia.
2. The disease passes through several definite phases.
3. There is a tendency toward spontaneous cure.
4. Pseudocoxalgia is one of the causes of osteo-arthritis in adult life.

BIBLIOGRAPHY

1. Calot, F.: Osteochondritis as a congenital malformation. Arch. de med. d'enfants, 1923, xxvi.
2. Calvé, J.: Sur une forme particulière de pseudo-coxalgie greffée sur des déformations caracteristiques de l'extrémité supérieure du fémur. Rev. de chir., 1910, xxx, 54-84.
3. Delitala, F.: Contribution for study of a typical disease of the upper end of the femur (Perthes' disease). Am. Jour. Orthop. Surg., 1914-1915, xii, 555-588.
4. Gauvain, H. J.: Pseudocoxalgia. Lancet, 1921, i, 403-404.
5. Heitzmann, O., and Engel, H.: Epiphysenerkrankungen im Wachstumsalter. Klin. Wchnschr., 1923, ii, 397-399.
6. Jansen, M.: On coxa plana and its causations. Jour. Bone and Joint Surg., 1923, v, 265-272.
7. Jansen, M.: Flattened hip socket and its sequelae. Jour. Bone and Joint Surg., 1923, v, 528-568.
8. Kidner, F. C.: Causes and treatment of Perthes' disease. Am. Jour. Orthop. Surg., 1916, xiv, 339-345.
9. Lecène, P. and Mouchet, A.: La scaphoidite tarsienne. Rev. d'orthop., 1924, xi, 105-112.
10. Legg, A. T.: An obscure affection of the hip-joint. Boston Med. and Surg. Jour., 1910, clxii, 202-204.
11. Lexer, E.: Die Entstehung entzündlicher Knochenherde und ihre Beziehung zu den Arterienverzweigungen der Knochen. Arch. f. klin. Chir., 1903, lxxi, 1-30.
12. Lovett, R. W. and Jones, R.: Orthopedic Surgery. New York: Wood, 1923, 699 pp.
13. McWhorter, G. L.: Operation on the neck of the femur following acute symptoms in a case of osteochondritis deformans juvenilis coxae (Perthes' disease). Surg., Gynec. and Obst., 1924, xxxviii, 632-637.
14. Osgood, R. B.: Discussion. Jour. Bone and Joint Surg., 1923, v, 276.
15. Panner, H. J.: A peculiar characteristic metatarsal disease. Acta radiol., 1921-1922, i, 319-333.
16. Perthes, G.: Ueber Osteochondritis deformans juvenilis. Arch. f. klin. Chir., 1913, ci, 779-807.
17. Perthes, G.: Ueber Osteochondritis deformans Coxae. Klin. Wchnschr., 1924, iii, 513-516.

18. PHEMISTER, D. B.: Operation for epiphysitis of the head of the femur (Perthes' disease). Arch. Surg., 1921, ii, 221-230.
19. RIEDEL, G.: Zur pathologischen Anatomie und Aetiologie der Osteochondritis deformans coxae juvenilis. Arch. f. path. Anat., 1923, ccxxiv, 335-423.
20. STRANGEWAYS, T. S. P.: Observations on the nutrition of articular cartilage. Brit. Med. Jour., 1920, i, 661-663.
21. VIGNARD: Sur le traitement opératoire de la coxalgie non suppurée. Lyon chir., 1921, xviii, 526-531.

TWO HUNDRED CASES OF PARALYTIC FOOT STABILIZATION AFTER THE METHOD OF HOKE*

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In the minutes of the Bone and Joint Section of the American Medical Association in session at New Orleans, May, 1920, the following discussion is credited, in substance, to the writer, in connection with a paper presented by DeForest Willard, of Philadelphia, on the Davis Subastragaloid Arthrodesis Operation for Paralytic Feet:

"The foot stabilization operation has developed to be the greatest single procedure thus far contributed to the surgical treatment of infantile paralysis. If a committee from the American Orthopedic Association were to collect, summarize, and condense all the work now being done on infantile paralysis, including the foot stabilization operation of Hoke, it seems that we should now have at our command sufficient effective procedures to make these cases reach their maximum recovery in the minimum time."

Since 1920, with the opportunity for more experience with the Hoke operation, we are more forcibly convinced of its entire efficacy in meeting the defects and deformities of paralytic feet. It is definitely established that an understanding application of this operation, together with the proper tendon transplantation and skeletal alignment, will meet all the surgical needs of the paralytic foot more nearly, more lastingly, and with more natural preservation of the function and appearance of the foot than any procedure yet devised.

In October, 1921, a comprehensive presentation of this operation was published by Hoke himself. Since that time a number of clinics here and there have tried out the procedure. In the clinic of the North Carolina Orthopedic Hospital, for the past three years, no other type of operation has been used for stabilizing paralytic feet, and this report is offered in review of the cases.

In this series of cases the involvement of the thigh muscles and the deformities of the hip and knee have been treated and braces applied when needed, but the fact is only mentioned and no detailed description is offered. Where surgical measures have been resorted to above or about

* Presented at the Annual Meeting of the American Orthopedic Association, May, 1924.

the knee, mention of the operation will be made in a summary, together with the type of brace, where a brace was used. One ambition of the Clinic where this foot stabilization operation originated was the elimination, so far as possible, of artificial apparatus. In this group of cases no braces were applied for primary foot conditions.

As in all surgical or medical cases an accurate diagnosis lends itself to intelligent application of a known therapy, so, in handling paralytic limbs does an accurate diagnosis of all factors entering into their instability become necessary to insure stability, with a given method of treatment.

It has been observed in many cases, really most cases, of paralytic involvement of the lower extremity, that the limb assumes a generally outwardly rotated position. The rotation may be only in the leg or it may be in the leg and thigh. In consquence of this, the osseous structures acquire a torsion in the length of their shafts, and not to recognize this nor attack it in the course of treatment of a case is to invite an improper alignment, a tendency to relapse of possibly other good work, and a disappointing result in the end. Since we are dealing here with the skeletal structure of the foot, reference to the thigh will not be made further than to say that the alignment of the femur must be obtained, and maintained, either by operation or by brace, before expecting well designed work on the leg and foot to hold.

In the shaft of the tibia of the paralytic leg pathological torsion is seen most frequently and to the greatest degree. The rotation is always outward and is frequently associated with a knock-knee deformity. The torsion occurs in amounts varying from 5 to 10 degrees, which may be inconsequential if left alone, to as much as 90 degrees, which places the tarsus at a right angle to the normal line of the leg. However good an operation one may be able to do on a foot, the maximum improvement will not be attained unless an osteotomy of the tibia is done and this torsion corrected when it is present to a crippling degree.

One must say that the work of Lovett and his students has contributed most to the detailed study and understanding of paralytic muscles. It is necessary to know the normal muscles about the foot and leg, the approximate and comparative degree of their involvement after poliomyelitic infection, and what disposition to make of any one, or group, contributing to deformity. It is needless to say at this time that the most skilled maneuvering of tendons will not meet the entire needs of paralytic feet, and tendon transplantation in this series of cases is done only as an associated procedure in developing a foot by stabilization. Like the torsion

in the bone shafts, however, unless careful disposition is made of unbalancing tendons they will contribute to an unsatisfactory result or to a relapse.

With the use of this operation on the foot, one finds tendon transplantation not so universally necessary for those muscles which have a fair degree of power left, but which would be sufficient to unbalance the average unoperated foot. The arthrodesed foot will hold its balance against a considerable pull from any of the muscles passing about the ankle. One then develops his own relative rule, usually by experience, as to whether, in a case of foot deformity, he will transplant a tendon or whether he will control the foot by stabilization alone. In this series of cases an error was made twice. Once a tendon was transferred to a new insertion in connection with stabilization, and over-corrected a foot; again, a tendon was not transferred to a new insertion and caused a relapse in a foot after operation.

In a given case after analyzing and dealing with, or planning to deal with, the factors of bone torsion and the disposition of unbalancing tendons, if any, one should classify the foot deformity. Each type of foot deformity is met by this operation in a definite way peculiar to that particular deformity. And here is where detailed and specific knowledge of foot anatomy and structural pathology must be exercised if the ideal end-result is obtained.

In addition to the general classifications of foot deformities, there are variations within each classification. A calcaneus foot (the classification) may be in extreme cavus also, or valgus, or both, or neither. Then all of these must be noted and met in the rearrangement of the bones of the tarsus at operation and a later manipulation. Precision must be practiced in sectioning the neck of the astragalus, in replacing the astragalar head, in sectioning the under surface of the astragalus and upper surface of the os calcis, and in securing their eventual resting relation. There is a refinedness of minute position and relation to be obtained between the astragalus, os calcis, scaphoid and cuboid bones particularly, and the bones of the whole foot in general, throughout all the classifications and variations of paralytic foot deformities.

The general classifications of club foot, flat foot, calcaneus foot, and flail foot will be used in presenting these cases, and only such reference will be made to the variations within the classifications as to make clear the reason for this or that technique in a procedure.

The operative approach for the foot stabilization is through the outer side of the ankle over the subastragaloid fossa. The incision reaches

from a point near the dorsum of the foot, backward to beneath the outer malleolus where the peroneal tendons pass. The approach is the same for all types of feet.

CLUB FOOT

Under the heading of club foot is included all those feet in varus, in equinus, equino-cavus, or any combination of these deformities. Applying the foot stabilization operation to these types calls in all for sectioning

FIG. 1

Case No. 692. A case of extreme paralytic club-foot.

FIG. 2

Case No. 692. After stabilizing the foot, lengthening the heel cord, transplanting the anterior tibial tendon to the centre of the tarsus and correcting the tibial torsion.

FIG. 3

Case No. 505. Paralytic club-foot with equinus and associated outward torsion of the tibia.

the under surface of the astragalus, freely clearing away the cartilage with a broad chisel; the same to the upper surface of the os calcis, so that when the two bones approach one another at the finish the broadest possible contact of raw surface may be had.

In the foot with varus deformity there is always more or less bony hypertrophy of the antero-external aspect of the os calcis, the cuboid bone,

and the head and neck of the astragalus. The physiologic interception to their antero-external development is displaced inward, hence their overgrowth. The head of the astragalus is external or superior to the median line of the foot, and the metatarsal shafts pitch inward, downward, and usually with some rotation.

The foot with simple equinus does not develop so much fullness about the antero-external aspect of the tarsus, but more noticeably an overgrowth downward and forward of the head and neck of the astragalus in the

FIG. 4

Case No. 505. After aligning the tibia, lengthening the heel cord, stabilizing the foot, and transplantation of the anterior tibial tendon to the centre of the tarsus.

FIG. 5

Case No. 347. Paralytic club-foot with extreme equinus and cavus. Moderate knock-knee and torsion of the tibia.

FIG. 6

Case No. 347. After osteotomy of tibia, heel cord lengthening, plantar fasciotomy, and club-foot and equinus type of stabilization.

median line, causing decided blocking to dorsiflexion of the forefoot even when the heel cord is lengthened. In the simple equino-cavus foot the latter pathology is a little more emphasized, together with a very taut plantar fascia and downward pitching of the metatarsals.

When the neck of the astragalus is sectioned, it is shortened and the hypertrophy of the os calcis and cuboid is relieved by a section from their

outer side, including their adjacent articulations. The head of the astragalus is removed from its bed, denuded of its cartilage together with the opposing cartilage of the scaphoid, and the head reshaped and transplanted back, somewhat reduced in size, and placed more nearly in its normal position. In a varus deformity the head will best be placed a little to the inner side of the median line of the foot; in an equinus and cavus foot the head is reduced in size and transplanted deep centrally on the end of the os calcis and as near as possible in its normal line. The alignment of the metatarsals may be disregarded at this time. The corrected position of the head of the astragalus is the secret of normal-looking, stable, well-balanced feet in this operation.

FIG. 7

Case No. 669. A case of ugly knock-knee and tibial torsion with a paralytic club-foot.

FIG. 8

Case No. 669. Corrected by high osteotomy of tibia, section of ilio-tibial band and foot stabilization.

At the time of operation it may be impossible to place the head of the astragalus in perfect position and hold it there, so it is done approximately and more attention given to shifting the foot slightly backward beneath the malleoli. In about five to six weeks after operative work has been done on the foot, a refining manipulation is given it. By this time there has taken place moderate union throughout the area of the fusion, but not so much union that one can not, with the thumb, force the astragalar head a few millimetres one way or the other until correct alignment is given it. At this time, also, from the structures having atrophied

and softened in cast, the entire forefoot may be molded in the hands of the operator to a corrected or overcorrected alignment, if desired. At the sitting for the foot stabilization operation, or at a different sitting within an interval of a few weeks, tendon transplantation or osteotomy of the tibia may be done if indicated.

Below is summarized the associated fasciotomies, tenotomies, osteotomies and tendon transplantations done in connection with the club foot cases.

Of the two hundred cases reported, one hundred and twenty-one cases are of the club foot type. The right foot was involved sixty-five times, the left fifty-six. Heel cord tenotomy was done alone in twenty-two cases, plantar fasciotomy alone in three cases, and heel cord tenotomy and plantar fasciotomy were done together in seventy-one cases. Osteotomy of the tibia was done ten times for pathologic torsion alone, one time for knock-knee alone, and forty-six times for knock-knee and torsion combined. In all, fifty-seven osteotomies of the tibia were done.

The anterior tibial tendon was transplanted to the centre of the tarsus in thirty-one club feet. The extensor proprius hallucis was transplanted into the head of the first metatarsal bone in six cases. The external hamstring was transplanted to the patella in three cases to reinforce a weak quadriceps muscle.

Soutter's operation, shearing off contracted structures from the anterior superior spine and side of the ilium, was done in two cases. A femur-turning operation was done in one case. Thirteen cases were furnished light leg braces to support weak thigh muscles.

Averaging about five and one-half weeks after operation, one hundred and seventeen feet had refining manipulation.

One foot in this classification relapsed after correction. This relapse was due to failure to estimate the strength of an anterior tibial tendon at time of stabilization. Later reworking the foot and transplanting the anterior tibial tendon to the centre of the tarsus gave a satisfactory result.

FLAT FOOT

The paralytic flat foot is one of the most uncomely deformities seen. It is not so disabling as some, but the weight of the body thrown for a number of years upon the arch of the foot stretches the restraining ligaments and so distorts the bone relations that to reconstruct them into improved position, with stability and comfort, has been a test of surgical mechanics.

The deformity in this type of foot is met by approaching the tarsus as in the club foot operation, but recognizing that the structural pathology is opposite. The hypertrophy of the head and neck of the astragalus is directed much to the inner side of the normal foot line. The medio-tarsus and metatarsals are in valgus and abduction to varying degrees.

At operation the sections from the under surface of the body of the astragalus and upper surface of the os calcis are made to get good broad

FIG. 9

Case No. 657. Severe paralytic flat-foot with hypertrophy and displacement of the inner aspect of the medio-tarsus.

FIG. 10

Case No. 657. Corrected by flatfoot-type of stabilization and transplantation of the peroneuslongus tendon into the heel cord.

bony contact. Here a point should be emphasized, and that is, taking off a substantial plane from the upper surface of the outer external angle of the os calcis to provide a raw resting place for the head of the astragalus to be transplanted. The subastragaloid fossa should be cleared of fat, and the periosteum raised away from the bones (astragalus and os calcis). Any chips of raw bone saved from working out the operation should be chinked in here to broaden the base and strengthen the fusion.

The neck of the astragalus is sectioned, shaped, and shortened to suit. The head is raised from its deep bed on the inner side of the foot and cleared of its cartilage, with the cartilage from the scaphoid articulation.

Corrective reconstruction of the flat foot now hinges on fashioning and fitting the head of the astragalus back to its neck with its base resting on the raw surface over the antero-external angle of the os calcis referred to above. The head should now be well away from its original bed and even external to the median line of the foot, so that the new weight thrust will be corrective rather than deforming. The forefoot is held in as much adduction as possible, the wound closed, and a well fitting plaster cast applied. Five to six weeks later a refining manipulation is practically always necessary here to improve the adduction and somewhat over-correct the foot. The flat feet do better when allowed to stay in cast for ten days longer than the average feet. The firm fusing in the new position means permanency, if the skeleton above has been lined up and necessary tenotomies and transplantations done.

In this series sixty-two cases of paralytic flat foot are reported, operated after the method described. The right foot was involved twenty-seven times and the left thirty-five. The heel cord was lengthened in eight cases. Osteotomy of the tibia was done twice for pathologic torsion alone, five times for knock-knee alone, and twelve times for knock-knee and torsion combined. In all, the tibia was sectioned nineteen times.

In eighteen cases the extensor proprius hallucis tendon was transplanted alone to reënforce the anterior tibial tendon. In two cases the extensor proprius hallucis and peroneus longus were transplanted together to reënforce the anterior tibial tendon. In three cases the extensor proprius hallucis, the peroneus longus, and the second, third, and fourth toe extensors were all transplanted together to reënforce the anterior tibial tendon. In eleven cases the peroneus longus and brevis were transplanted together into the heel cord and in three cases the peroneus longus was transplanted alone.

At the end of six weeks after operation a refining manipulation was done on fifty-eight feet.

Two cases had a Soutter operation to relieve hip flexion. A femur-turning operation was done on four cases. A light leg brace was applied for weak thigh muscles in thirteen cases.

There was one case of over-correction. The flat foot type of stabilization was done together with the transplantation of the extensor proprius hallucis to the anterior tibial tendon. In this case the stabilization alone would have held the foot, and transferring the extensor proprius hallucis to the anterior tibial tendon overbalanced it. A second operation placing the extensor proprius hallucis tendon into the middle of the tarsus left the foot balanced.

CALCANEUS FOOT

The calcaneus type of paralytic foot deformity has been in the past one of the most discouraging to correct, and hold, by surgical measures. The difficulty in controlling the calcaneus foot has probably given impetus to the development of the various operations for stabilizing feet. When the structural pathology of the skeleton in the calcaneus foot is analyzed and this stabilization procedure applied to it, together with the shifting of the foot backward on the leg, permanent correction and stability can be had, and a foot which is quite normal in appearance both in and out of a shoe.

In the calcaneus foot the Achilles tendon is weak or paralyzed. This structure in a normal foot is part of the physiologic control to the superior inferior growth of the bodies of the astragalus and os calcis. In the calcaneus foot the physiologic control of the growth of these bones is lost. Their superior-inferior diameters are decidedly increased, thrusting the heel downward and the forefoot forward and upward. The unequal muscle pull adds to the deformity. Some of the feet in this classification are simple calcaneus feet, some are in position of calcaneo-valgus, while some are in calcaneo-varus. In describing the application of the operation here the subastragaloid sectioning is emphasized.

The incision exposes the heel bone with a prolongation of the upper aspect of its body toward the astragalus and the astragalus has an unusual depth toward the os calcis. It is easy to see the increased depths of the superior inferior diameters of the opposing bones. With a broad chisel a deep section is lifted from the astragalus and os calcis at this site. The sum of the depths of these two fragments in the bad cases will approach an inch. Removing these sections properly represents the secret of the success of this operation with this type of foot. When the foot is shifted backward, which can easily be done here, the raw bony surfaces of the os calcis and astragalus impact broadly and solidly together. The heel cord is relaxed by this shortening, put at rest, and allowed to recover tone and strength. In fact, it has been noticed that after such an operation and rest in plaster a gastrocnemius soleus group which appeared to be completely paralyzed before operation, after operation shows a helpful degree of power.

If the calcaneus foot has associated a valgus or cavus forefoot, this associated deformity is met by placing the head of the astragalus in a new position, as was brought out with some detail above in connection with describing the treatment of the valgus and cavus type of foot deformity.

In dressing these cases after operation care should be exercised to shift the foot backward and upward until the space created by the subastragaloid sectioning is dissipated, and the two bones firmly face to face. The plantar fascia is sectioned, if indicated, and any tendons calling for transplantation are disposed of. Plaster dressing is applied with the foot in equinus and the knee slightly flexed.

Six weeks later the foot is manipulated. When this is done an assistant holds the heel well up and the forefoot is molded to alignment, against this protection. After manipulation it is well to allow the foot another ten days to two weeks in plaster, when it is ready for massage, a shoe, and the test of walking.

FIG. 11

Case No. 313. Paralytic calcaneus foot.

FIG. 12

Case No. 313. Corrected by calcaneus type of foot stabilization.

Seventeen calcaneus feet are included in this series. Eleven occurred in the right foot and six in the left. There was one osteotomy of the tibia done to correct pathologic torsion and knock-knee.

The peroneus longus and brevis tendons were transplanted into the heel cord in three cases. The external hamstring was transplanted into the patella in one case of associated quadriceps weakness.

Two cases were furnished light leg braces for weak thigh muscles. Seventeen cases had final manipulation, and so far no cases of relapse have been seen.

FLAIL FOOT

In treating the flail foot, particularly good fusion is sought between the astragalus and os calcis, and this operation gives satisfaction in this connection. In our classification of paralytic feet not a great many deformities are called by the term "flail foot." Our flail feet are usually in a mild drop-foot position. As has been noticed, a great many really flail feet will assume a varus or valgus deformity. These cases get the club foot or flat foot type of stabilization, and are so classified.

FIG. 13

Case No. 582. Left paralytic flail foot—drop or dangle foot.

FIG. 14

Case No. 582. After shifting the foot backward with a simple stabilization.

The cartilage is freely removed from the head of the astragalus in the flail feet and from the opposing surface of the scaphoid. When these structures fuse together, with the foot shifted slightly backward and the forefoot manipulated to alignment, the foot is stable, has no tripping toe-drop and reaches its maximum of recoverable function.

Eight flail feet, as such, are reported here. Two are in the right foot and six in the left. In four cases, osteotomy of the tibia was done to correct pathologic torsion and knock-knee.

A Soutter procedure for flexed hips was done on three cases. All the feet had refining manipulation at the end of six weeks, and six cases were furnished light leg braces for weak thigh muscles.

A notation of several follow-up observations has been made in the records from the out-patient department of the hospital on each of these cases.

The average age of the patients at the time of operation was eleven years. The youngest patient operated upon was four years, the oldest thirty-five years. The ideal age is eight years, after which there is no age limit to the possible application of the procedure.

FIG. 15

Case No. 538. A case which was being treated by braces on these lines.

FIG. 16

Case No. 538. Prepared for braces by lining up the feet and legs.

FIG. 17

Case No. 538. In braces.

METATARSUS PRIMUS VARUS OR HALLUX VALGUS?*

BY WALTER TRUSLOW, M.D., F.A.C.S., BROOKLYN, N. Y.

This paper presents a new name to an old subject, as investigation suggests that there has been a faulty anatomic basis in the use of the familiar name. It offers an operative attack other than has heretofore been used, and endorses it because it is based on a better understanding of the cause and mechanics of the disability; because it attacks the deformity at its source and corrects it on proper mechanical principles, with practically no possibility of relapse; and because it is a simpler operation, with less danger of skin infection and a quicker return to normal function than is possible with the usual operations for hallux valgus.

The greatly distorted forefoot, which is usually named hallux valgus from its most striking feature, which might be named "Diamond foot" from its general appearance (see Fig. 1), is here named metatarsus primus varus, because of the oblique (varus) position of the first metatarsal bone. (See Fig. 3 and Fig. 4.) The gross appearance of the foot shows clearly this oblique position of the first metatarsal bone in relation to the inner side of the tarsus (see Fig. 1). Indeed, in the foot under description, the usual longitudinal axis of the inner side of the normal foot is broken into four oblique axes — that for the great toe, that for the first metatarsus, that for the midtarsus, and that for the os calcis; suggesting still another name for this deformity — "Zig-zag foot" (see Fig. 3).

But study of roentgenograms taken from dorsoplantar exposure is essential (see Figs. 5, 7, and 8). Such a study reveals a distinct angular divergence of the first metatarsal bone from the second, a wedging either of the internal cuneiform bone or of the proximal end of the metatarsal or rarely the presence of a wedge-shaped "intermesial bone" (Dwight), and an axis of motion in the tarso-metatarsal joint at an oblique instead of a transverse position to the long axis of the foot (see Fig. 4). This, as the writer sees it, is the primary deformity. Unless there are complications, the roentgenogram reveals also an interosseous triangular space, widest between the heads of the first and second metatarsal bones (see Fig. 3). The outward deviation of the great toe is secondary, as are also any bony enlargements or hypertrophied sesamoid bones which may be found at the

* Read at the Annual Meeting of the American Orthopedic Association, May, 1924.

distal end of the metatarsal bone (see Figs. 5 and 7). These findings — a first metatarsal in varus relationship to the bulk of the foot, a bone wedging at the tarso-metatarsal joint, an oblique position of the axis of motion of that joint and an interosseous triangular space—are constant in diamond foot. There is no bone pathology at the proximal joint. That is, the wedged bones show a normal histologic condition, with no sign of

FIG. 1.

Plaster mould of foot before operation. (See also Fig. 5.)

FIG. 2.

Plaster mould of foot after operation. (See also Figs. 1 and 6.)

present or past inflammation, and the joint surfaces are clear cut. There is every appearance of an *anatomic variation*, inherent in the individual's growth and development, and not an acquired deformity.

A number of questions arise as to the origin of the anatomic variation described. Is it hereditary? Is it a reversion to the branch-grasping, Simian type of great toe, described by Morton? Is it a persistence of the

A-A
METATARSUS PRIMUS VARUS

B-B
DIAMOND FOOT

C-C
ZIG ZAG FOOT

FIG. 3.

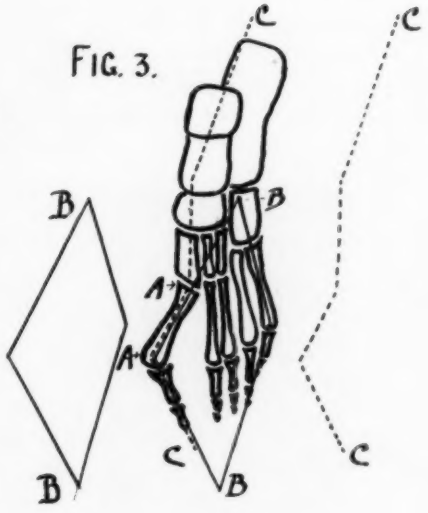


FIG. 3

FIG. 4.

METATARSUS PRIMUS VARUS

[VARUS OF FIRST METATARSAL BONE]

A-REDUNDANT BONE IN INTERNAL CUNEIFORM

B-RARELY FOUND AS AN INTERMESIAL BONE [DWIGHT]

C-OFTEN FOUND IN FIRST METATARSAL

PLANE OF JOINT: OBLIQUE IN A & B
TRANSVERSE IN C

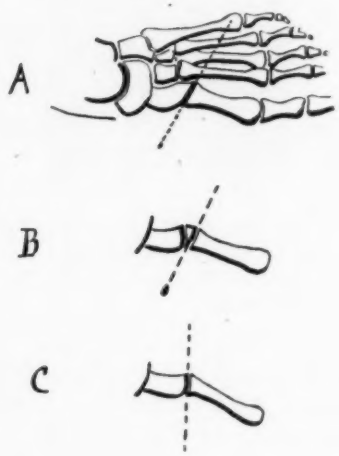


FIG. 4

human embryo great toe, described by Lebloc? This phase of the subject will require more study than the present writer has yet been able to give to it. But the conviction grows that, whatever the biologic origin of this variation from the normal, it is a very real variation, is non-pathologic, is not uncommon, and is disabling.

FIG. 5.

Roentgenogram of feet (see also Fig. 1) before operation. Note enlarged sesamoid bones.

At the distal end of the first metatarsal bone may be found either no pathologic changes or changes that have been acquired by arthritic or shoe-deforming factors. Frequently a foot with a clinical appearance of much deformity will show by roentgenogram very few pathologic changes at the great toe joint (see Fig. 8). The bone ends will be but little enlarged, if at all; the joint surfaces are clear; there is only a distinct lateral (parietal) subluxation of the bones of the toe. And by operation the long extensor tendon is found shortened and displaced and the parietal side of the joint

capsule is contracted. This non-pathologic, diamond-shaped foot is the one particularly under discussion, although the operative procedure to be described is applicable (with modifications) to some of the feet which show bony changes at the great toe joint.

On the other hand, there may be marked pathologic changes at the metatarsal head (see Figs. 5 and 7)—spurs and bony outgrowths, some-

FIG. 6.

Roentgenogram of feet (see also Fig. 2) after operation at proximal end of first metatarsal bone. Note: The displacement of left great toe was easily corrected by a few weeks of bandaging.

times bone-bridging with partial or complete ankylosis, and enlargements of the sesamoid bones, with or without arthritic attachment to the first or second metatarsal heads. The condition may be acute, with marked inflammatory involvement of the neighboring soft tissues—the inflamed bunion—or chronic and inactive.

The point made is that the anatomic variation, found at the proximal end of the first metatarsal bone, is primary and fundamental when con-

FIG. 7.

Roentgenogram of feet with metatarsus primus varus. Redundant bone is in internal cuneiform bone, in the right foot; in first metatarsal, in left foot. Marked redundant bone at distal end of left metatarsal bones.

sidering the patient's disability or treatment; that such changes as are found at the distal end of this bone are secondary in origin and development and that although because of acute inflammation and tender bony points, the distal end of the bone may be the seat of the more distressing symptoms, cure of the deformity and of the mechanical disability is impossible unless redressement of the proximal deformity is accomplished.

FIG. 8.

Roentgenogram of feet with metatarsus primus varus. Note redundant bone in internal cuneiform bone; also note redundant bone at distal end of first metatarsal.

What shall be done with this deformity? It is undoubtedly the experience of most orthopaedic surgeons that the relief which is afforded by mechanical means—larger and accommodatingly-shaped shoes and by proper foot-bracing—is sufficient to meet the wants of most patients. But there are some who wish more, and some who should have more done for them. The decision to operate is best arrived at as the result of a request by the patient. Unrelieved pain may bring this request, pride

in foot appearance may do so and not infrequently the difficulty in obtaining ready-made shoes to fit the deformity sends the patient to the surgeon.

Having decided to operate, what should be done? The operation which is here presented is simple in principle, is easily performed, presents a minimum of skin infection risk, and insures a quick convalescence and speedy return to weight-bearing function. It consists in simple dorsal incision, cuneiform osteotomy of the redundant bone wedge at the metatarso-cuneiform joint (see Fig. 9), tenotomy of the shortened long extensor tendon and subperiosteal separation of the contracted parietal capsule of the metatarso-phalangeal joint, and manual correction of the deformity,

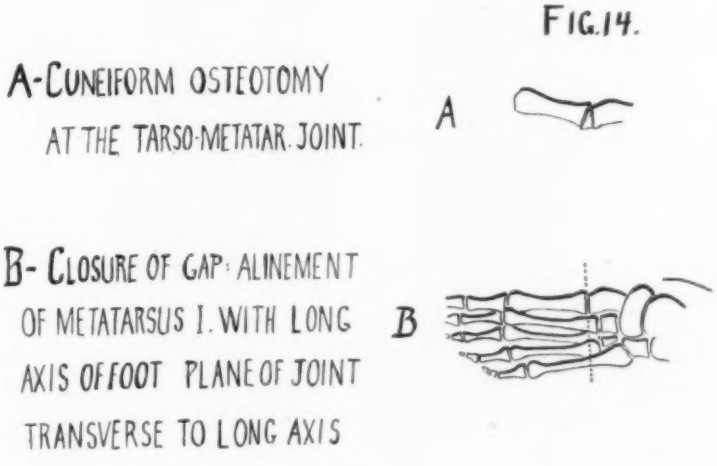


FIG. 14.
A-CUNEIFORM OSTEOTOMY AT THE TARSO-METATAR. JOINT.
A
B- CLOSURE OF GAP: ALINEMENT OF METATARSUS I. WITH LONG AXIS OF FOOT PLANE OF JOINT TRANSVERSE TO LONG AXIS
B

FIG. 9

with closure of the interosseous space (see Fig. 9). Interrupted silkworm gut sutures are used to the skin. The sterile three-yard gauze roll is wound snugly around the waist of the foot and between the first and second toes, and in such a manner around the great toe as to maintain the straight line. Subsequent dressings continue this snug waist dressing and great toe bandage splinting. Appropriate use of adhesive plaster outside the dressing aids this splinting.

If a proper foot brace has been supplied, the patient may begin to put weight on the foot in two weeks. A foot brace should be worn three months—longer if marked flat foot or metatarsal proneness persists. The foot brace (see Fig. 10) should include the flexible metatarsal extension

forward. A shoe with straight inner sole must be worn. A few weeks of foot massage and the contrast bath hasten the restoration of function.

Such is the operation for uncomplicated varus of the first metatarsal bone, with secondary non-inflammatory hallux valgus. Any bone-blocking structures found between the heads of the first and second metatarsal bones must also be removed before the alignment of the entire great toe—metatarsal bone and phalanges—can be attained or hoped to be maintained. Enlarged sesamoid bones and much enlargement of the parietal and the

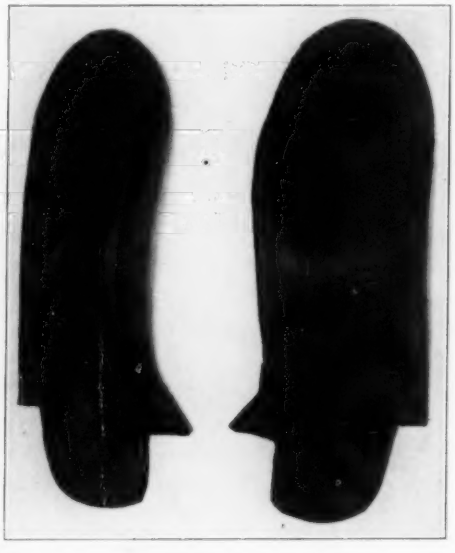


FIG. 10.

The writer's foot braces for metatarsal distortion.

plantar sides of the metatarsal heads can be removed through the original dorsal skin incision. A strong bone curette is useful in getting these out. The point is that much of the blocking bone is found in the space between the metatarsal heads and that the operator works in that space until he is able to get the alignment of the entire great toe parallel to the long axis of the foot.

Some gross enlargements of the metatarsal head, on the mesial side, will require separate approach on that side, but it is surprising how much access may be obtained from the more favorable dorsal incision. Again,

these great toes are often abnormally long and the tendon imbalance is quite a factor in the deformity. The removal of more bone from the proximal end of the first metatarsal, when correcting the wedge deformity at that location, will improve these factors.

The writer repeats, however, that if definite operative correction is necessary at the distal end of the first metatarsal bone, such correction is unscientifically inadequate and deformity will tend to recur unless the fundamental deformity at the proximal end is also corrected; and that this correction at the proximal end, with minor tendon and ligament cutting, is all that is necessary in many cases.

In this discussion nothing has so far been said of the other deforming foot factors which often accompany the condition described. The dorsal approach may be useful in these. True plantar flat foot may be helped by so planning and executing the wedge removal that the gap to be closed may be on the plantar as well as on the parietal aspect of the metatarso-cuneiform joint. Again, the roentgenogram may show a decided valgus position of the remaining metatarsal bones, most marked at the second, and lessening toward the fifth. A wedge removal, base to the mesial side of the foot, may be made between the proximal ends of the second and third metatarsals and their neighboring tarsal bones, and will correct this. Also in functional claw-toes, the removal of more or less of the proximal ends of the second, third, or even the fourth metatarsal bones will bring about a better toe tendon balance, with easier approach through the same dorsal incision, and with better functional result to the metatarsal arch than by operations which remove bone at the distal ends. This, of course, will not correct true ankylosed hammer toes.

That much of the procedure here described is applicable in certain phases of paralytic foot deformity is obvious, but not within the scope of this paper.

SUMMARY

This paper presents a new name—metatarsus primus varus—for a well known foot deformity; the name indicates the situation of the primary focus of that deformity at the proximal end of the first metatarsal bone; it notes the constant varus position of that bone and the lateral bone wedging at its proximal joint, and considers this an anatomic variation and not the result of inflammation or of the use of faulty shoes; it further considers that the hallux valgus deformity is acquired, and that it may be the result of the varus of the first metatarsal, although faulty shoes and chronic arthritis may also be causative factors. The writer presents

the thesis that any operative procedure that does not include the correction of the deformity at its proximal focus is unscientific and inadequate; and that simple cuneiform osteotomy at the metatarso-cuneiform joint, with the redressement of certain secondary changes, is adequate and permanent. Other accompanying foot deformities are briefly discussed.

DISCUSSION

Dr. A. H. Freiberg, Cincinnati, Ohio: I would like to ask Dr. Truslow whether he has any evidence of the existence of such varus condition in the first metatarsal of persons who have not yet acquired a so-called clinical hallux valgus. If this is a primary condition of the foot it ought to be evident at a very early period.

Dr. E. W. Ryerson, Chicago: It seems to me that a paper of this sort ought to be talked about more than it appears this is going to be. About every five years somebody gets out a theory about the etiology of hallux valgus. Only a few years ago our recently deceased member, Dr. J. K. Young, informed us that the intermetatarsal bone was usually the cause, because he saw many cases where the intermetatarsal existed. It seemed to me that every one of these cases which Dr. Truslow showed was a case of primary intermetatarsal. You realize that when the foot comes down into the shoe the toes are deviated by poorly fitting shoes and the metatarsal is forced inward. In support of Dr. Truslow's theory I will state that I saw two cases of primary metatarsus varus in small children who never wore anything but properly constructed moccasins, but if you inquire into the majority of cases of hallus valgus you will find that it is due to poorly fitting shoes and that the toe gradually pushed the metatarsal bone toward the other one. Our well-known Dr. Evans, who writes the health news in the *Chicago Tribune*, informed his over-a-million readers a week ago that the cause of bunions was a sesamoid bone that stuck up between the first and second metatarsal bones, and that if this were removed the bunion would get well. Moynihan wrote an article some years ago in which he called this condition a true hallux valgus.

Dr. A. H. Cilley, New York City: There was a case at the Hospital for the Ruptured and Crippled in a child two weeks old that showed a very similar roentgenogram to this picture drawn by Dr. Truslow.

Dr. Walter Truslow, Brooklyn, N. Y. (closing the discussion): Dr. Freiberg's question I think will need a lot more study to answer. As you will recall, he asked if this primary condition is to be met in children or is it something acquired with age. I have felt that it was a primary condition.

In answer to Dr. Ryerson: in some, yes; but we have not had sufficient X-ray study. I am going to take roentgenograms of the feet of children as fast as I can get hold of them. I have seen one or two which made me think it was found in children. I want to tell Dr. Ryerson that every one of these did show a definite wedging at the proximal end of the metatarsal bone and when that wedging is found, while I believe it is augmented by wrong shoes and pointed toes, I cannot help but feel that it is a primary thing and I do not think it is quite fair to put it up entirely to wrong shoes.

THE ANATOMY OF THE LUMBO-SACRAL REGION IN RELATION TO SCIATIC PAIN

BY MURRAY S. DANFORTH, M.D., PROVIDENCE, R. I.,
AND PHILIP D. WILSON, M.D., BOSTON, MASS.

Sciatica as a Symptom. The following observations are the result of an investigation which the writers began three years ago in an attempt to acquire additional knowledge of the causes of sciatic pain. That this symptom may result from many different conditions is well known. In some cases the causes are of a general or constitutional nature, such as diabetes, syphilis, alcoholism, lead poisoning, etc., which produce an inflammatory or degenerative change directly in the nerve tissue. In other cases they are purely local in action and produce pain either by direct pressure upon, or irritation of, the sciatic nerve at some point in its course or at its roots. Among the latter causes are vertebral tuberculosis and neoplasms, intra-pelvic or extra-pelvic tumors or inflammations, and many other conditions. The number of possible causes is legion and need not be given in detail, as sciatica of this purely secondary type presents no special problem—at least from the standpoint of etiology.

Essential Sciatica. Sciatic pain, however, as commonly seen, is not of this type. In the great majority of cases no causes of the above nature can be demonstrated even upon careful examination. Sciatica of this type is often termed *essential* or *idiopathic*, except in Europe, where the name *sciatic scoliosis* is more frequently used. It presents a clinical picture sufficiently striking to have earned for it a description as a disease entity. The neurologists usually regard it as a neuralgia or a neuritis, similar in nature to the classic trigeminal neuralgia, but orthopaedic surgeons consider that the neuritis is only a secondary manifestation and that the primary lesion is to be found in a pathologic process involving the lower lumbar spine or sacro-iliac joints.

Symptomatology. The condition occurs chiefly in adult life, more commonly in men, and in occupations which necessitate heavy manual effort and exposure. There is frequently a history of preceding trauma. The pain often begins as a lumbago, and after a variable period of from a few days to several weeks makes its appearance in the thigh, leg, or ankle. Frequently the back pain disappears with or before the onset of the leg pain. Often the patient does not associate the latter condition with the

former. On the other hand, the pain may begin in the leg, and there may be no pain, or only very slight pain, in the back.

The pain may be constant or spasmodic, may be aggravated by movement, coughing, and sneezing, or by assuming certain positions. Its intensity varies from a mild to a severe type, with periods of acute exacerbation. The pain usually follows the course of the sciatic nerve to the knee and then is referred to the outer side of the leg and ankle. During the period of acute pain and subsequently, for a varying period, a spinal deformity is present, the trunk being tilted to one or the other side.

The duration of the attack varies from a few weeks to several months, or even years. There is a definite tendency to spontaneous recovery. Recurrence of the attack is not uncommon, often after an interval of several years.

Bibliographic Review. Ischias was the name applied by the ancients to all painful affections of the lower leg, including sciatic pain. Cotugno, in 1764, was the first to distinguish it from other conditions under the name "ischias nervosa postica." Following this, it was for a long time known as Cotugno's disease. Valleix, in 1841, described the clinical appearance of the condition and called attention to the tender pressure points over the sciatic nerve (Valleix's points). Romberg attempted to interpret these phenomena from the standpoint of pathologic anatomy. Lâsegue described the symptomatology and called attention to the well known sign which bears his name. This consists in flexing the thigh while the knee is extended, the test being considered positive when pain is evoked in the course of the sciatic nerve.

The purely neurologic phenomena have been described by many writers. Landouzy, in 1875, called attention to the local adiposity on the affected side, the lessened temperature and the muscle atrophy. Charcot, Gunion and Parmentier note the frequency of partial affections of the nerve. Babinski pointed out the frequent absence of the Achilles reflex. Rousset (1804), Martuiet (1825), Lagrelotte (1869) and many others have described the sensory disturbances which may accompany the condition, including changes in cutaneous sensibility for tactile and thermal stimuli.

Charcot, Babinski and Brissaud were the first to call attention to the spinal deformity. According to Babinski, in certain cases of sciatica a condition is present which is characterized by an inclination of the spine toward the unaffected side. Brissaud was the first to use the term "sciatic scoliosis." Later he distinguished between homologous and crossed forms of the scoliosis, depending upon whether the deviation was towards the

side of the sciatica (scoliose sciatique homologue) or away from it (scoliose sciatique croisée). Remak, in 1890, described an alternating type of sciatic scoliosis.

A vast amount of literature dealing with different phases of the subject has been written in recent years. We have collected a bibliography numbering 520 articles, which is far from complete. The great majority deal with the clinical aspects of the condition and especially with different forms of therapy. Goldthwait was the first to investigate the problem from the anatomic and mechanical standpoint, and his studies, fundamental in character, provided the starting point which has resulted in bringing the condition within the scope of orthopaedic surgery. He also first called attention to the frequent occurrence of vertebral abnormalities, such as sacralization of the transverse process of the fifth lumbar and asymmetrical development of the posterior articulations, and pointed out the etiologic rôle which they, in combination with faulty body posture, might play in the production of sciatic pain.

PLAN OF INVESTIGATION

The writers determined to study the anatomy of the lumbo-sacral and sacro-iliac region by actual dissection; then to take a series of patients falling in the category of sciatic pain without obvious cause and to study them clinically as carefully as they could, making the usual routine examinations of the spine and lower extremities, together with neurologic and roentgenologic examinations.

ANATOMY

We began with the anatomy, making dissections at the Harvard Medical School. We were able to obtain twelve subjects and we shall try by means of our charts to show the conditions actually existing.

As a basis for illustrating our work let us turn to a drawing of the lumbo-sacral plexus (Fig. 1).

This figure shows that the nerve roots that would interest us are Lumbar 4, and 5 and Sacral 1, 2, and 3. The peroneal or external popliteal division of the sciatic comes from Lumbar 4 and 5 and Sacral 1. The tibial or internal popliteal division of the sciatic comes from Lumbar 4 and 5, and Sacral 1, 2, and 3; the superior gluteal from Lumbar 4 and 5, and Sacral 1; the obturator from Lumbar 2, 3, and 4 and the femoral or anterior crural also from Lumbar 2, 3, and 4.

The superior gluteal and the divisions of the sciatic interest us chiefly in our study, as the nerve symptoms are usually in their distribution.

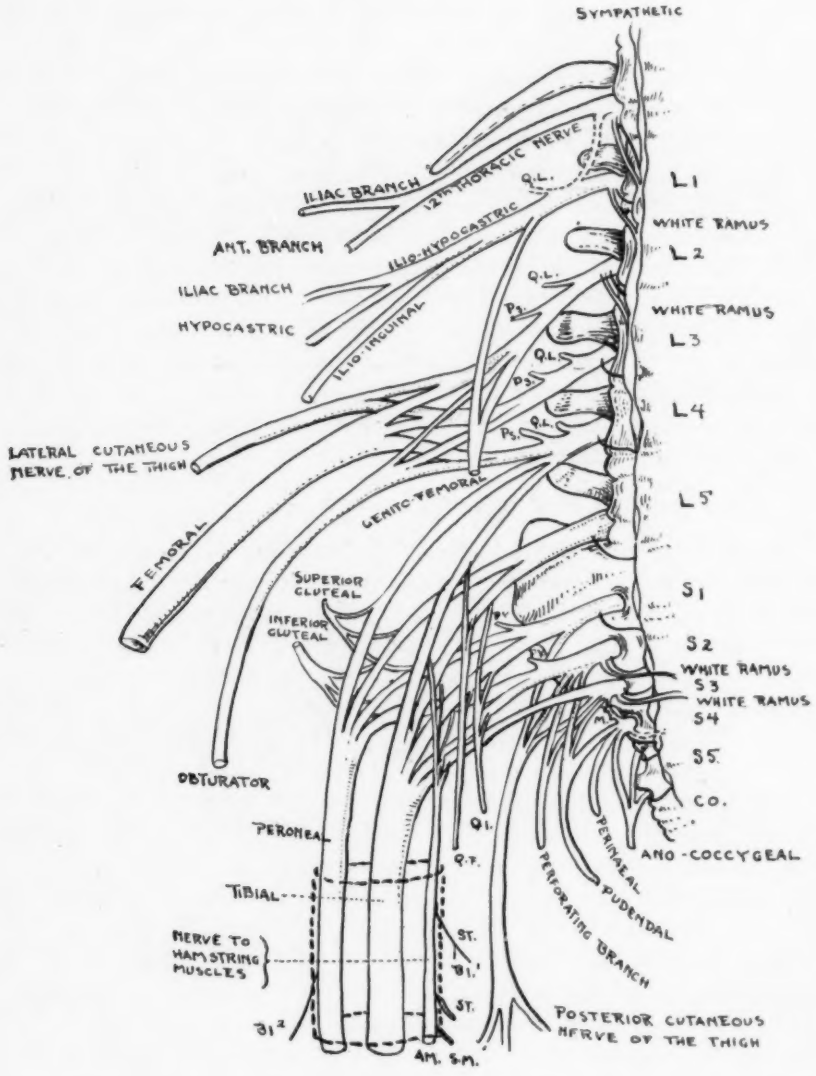


FIG. 1

Drawing of lumbo-sacral plexus (after Cunningham). Note derivation of the peroneal and tibial divisions of the sciatic nerve; also of the superior gluteal, obturator, and femoral nerves.

While the figure we have used is modelled after Cunningham, there is considerable variation in the derivation of these nerves. This is well shown by List 1 as regards the superior gluteal nerve.

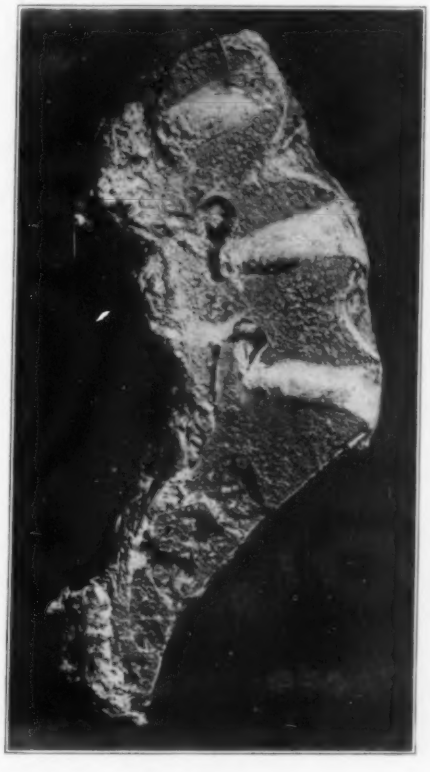


FIG. 2

Saggital section through the lumbo-sacral spine about ½-inch to the right of the median line, showing composition of the intervertebral canals and the positions of the nerve roots.

LIST I

Derivation of Superior Gluteal Nerve, According to Various Authors

Gerrish—L. IV., L. V., S. I.
Kocher—L. IV., L. V.
Kraus—L. IV., L. V., S. I.
Cunningham—L. IV., L. V., S. I.
Spalteholz—L. IV., L. V., S. I., S. II.

FIG. 3

Drawing illustrating the relative sizes of the intervertebral canals of the lumbar spine; also the sizes of the corresponding nerve roots.

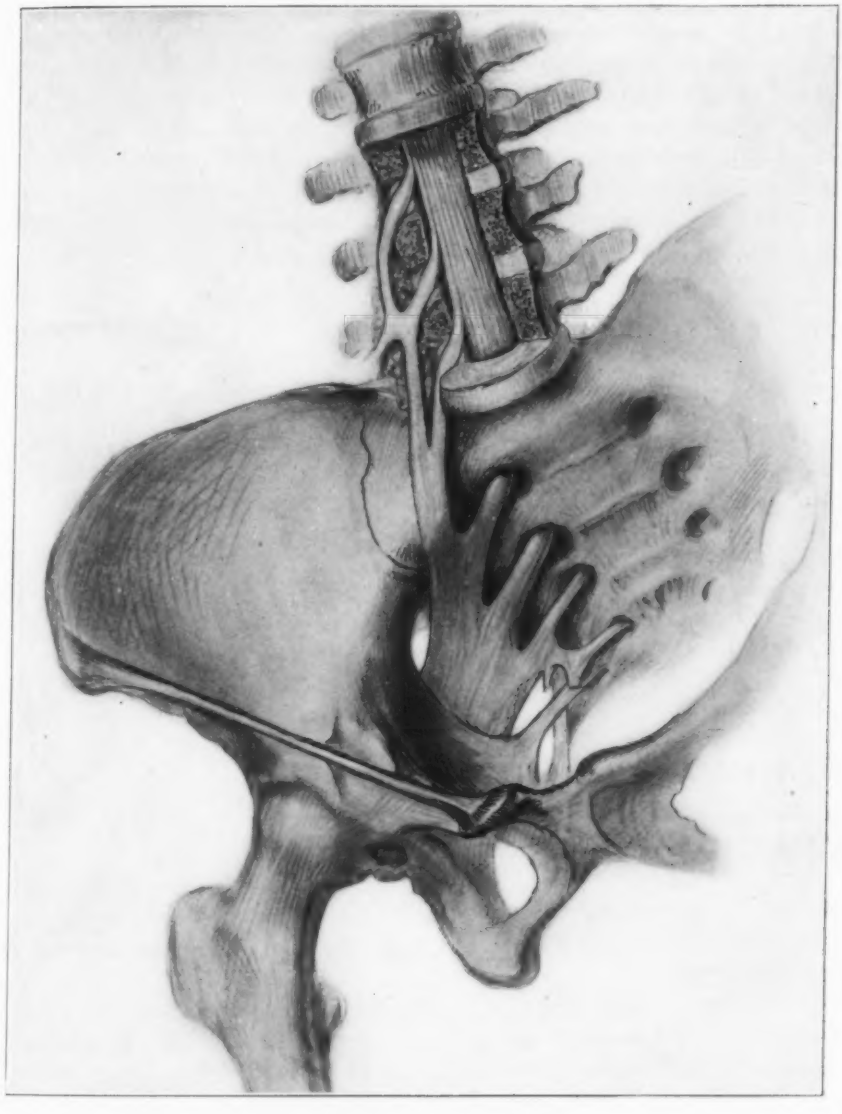


FIG. 4

Drawing from dissection, showing the relations of the sacral plexus. Note especially the course of the fourth and fifth lumbar nerve roots and their relations to the fifth lumbar intervertebral disc and to the sacro-iliac joint.

In our dissections we first studied the lumbar spine and sacro-iliac joints. In general the anatomy of this region is familiar, but it seems worth while to emphasize the composition of the intervertebral canals through which the nerve roots emerge.

Fig. 2, a photograph of a section through the lumbo-sacral spine, shows the composition of the intervertebral canal. Briefly: above is the inferior intervertebral notch; below, the superior intervertebral notch. In front is a little of the posterior part of the body above, a little of the intervertebral disc, and a little of the posterior part of the body below.

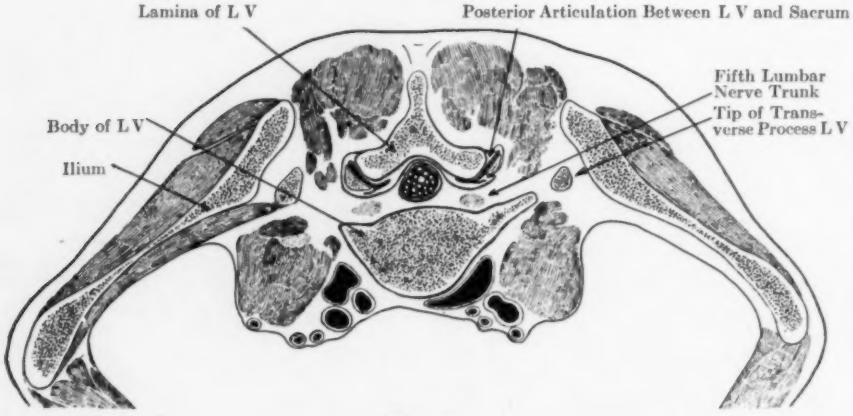

Lamina of L V
Posterior Articulation Between L V and Sacrum
Fifth Lumbar Nerve Trunk
Tip of Transverse Process L V
Body of L V
Ilium

FIG. 5

Tracing from frozen section through fifth lumbar vertebra, showing relations of fourth and fifth lumbar nerve roots. Note position of fifth root directly anterior to posterior articulation between fifth lumbar vertebra and sacrum. Effusion within this joint might easily cause compression.

Behind is the posterior articulation, and this last is, it seems to us, a feature of considerable importance when the relations of the nerve roots are considered.

The figure also shows that the posterior superior articular facet reaches upward toward the inferior intervertebral notch of the body above, and further shows the position of the nerve roots in the canals.

Next we studied the sizes of the intervertebral foramina or canals in relation to the sizes of the nerve roots passing through them. Fig. 3 illustrates the anatomic relations. We found, in our dissections, the foramen between the fifth lumbar vertebra and the sacrum always the smallest, that between the fourth and fifth vertebrae the next larger, and

that between the third and fourth usually the next, although sometimes the second and third were about equal. Quite contrary to the size of the foramen or canal is the size of the nerve root enclosed. The fifth was always the largest, the fourth next to the largest, and the third next smaller as a rule, although sometimes the second and third roots were about equal in size. Otherwise expressed, the largest nerve root (the fifth) always had the smallest canal, and frequently it almost filled the canal, while the fourth rarely filled the opening, and the second and third never.

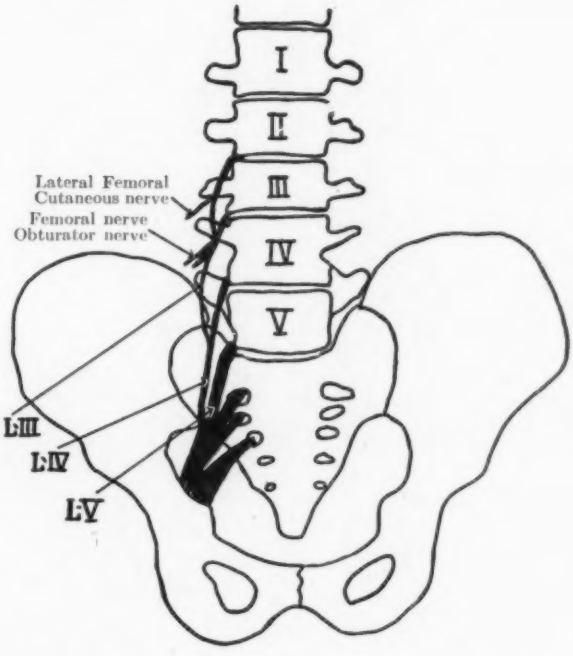


FIG. 6

Drawing from Subject I. Here L III, as well as L IV and L V, contributes to the lumbo-sacral cord.

Passing to the structures outside the canals, the courses of the fourth and fifth lumbar nerves and the first, second, and third sacral nerves are of particular interest.

Figs. 6 to 13 inclusive, show the arrangement and relations of the nerves in dissections of eight cadavers. The fourth lumbar nerve after leaving the intervertebral foramen (for example the fourth nerve in Fig. 6)

lies closely in contact with the lateral surface of the intervertebral disc between the fourth and fifth bodies and their articular margins, and descending lies on the anterior surface of the transverse process of the fifth. This was true in all of our dissections where the fourth root sent a branch to the lumbo-sacral cord. From its position on the transverse process, it continues downward across the space between the process and the sacrum, to lie on the ala and anterior surface of the sacrum.

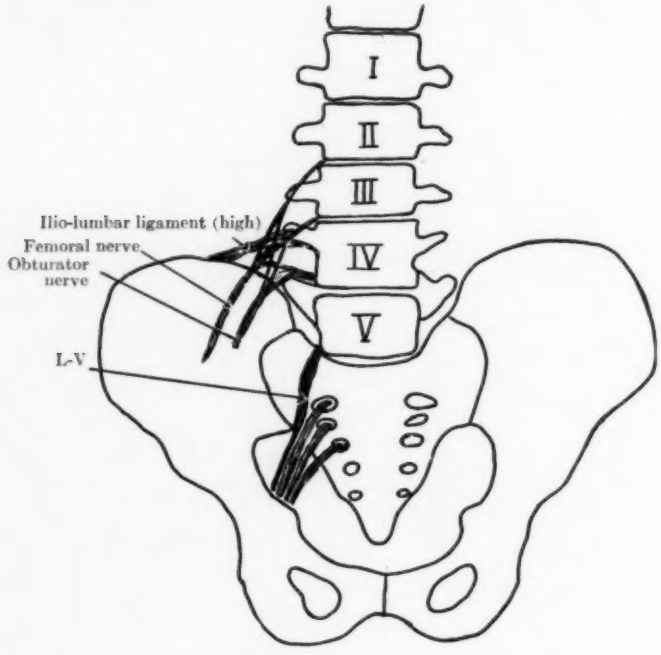


FIG. 7

Drawing from Subject 2. Note that here there is no branch from L IV to the lumbo-sacral cord.

In five of the subjects (Figs. 6, 8, 10, 11, and 13) it joined the fifth nerve before reaching the great sciatic notch.

In two subjects (Figs. 9 and 12) it emerged from the pelvis before joining the fifth nerve.

In its course on the sacrum it always lay mesial to the sacro-iliac joint until it reached the great sciatic notch, where it was sometimes mesial to it and sometimes lay directly on the joint.

The fifth root (for example, Fig. 6), after emerging from the foramen between the fifth lumbar body and the sacrum, lies in direct contact with the lateral margin of the inferior surface of the fifth, with the intervertebral disc, and with the lateral margin of the superior articular surface of the sacrum.

In two subjects (Figs. 10 and 13) at this point it was partly embedded in a canal formed by spurs on the lateral margins of these two articular surfaces, and apparently could be very easily affected at that stage, either mechanically or by an inflammatory exudate.

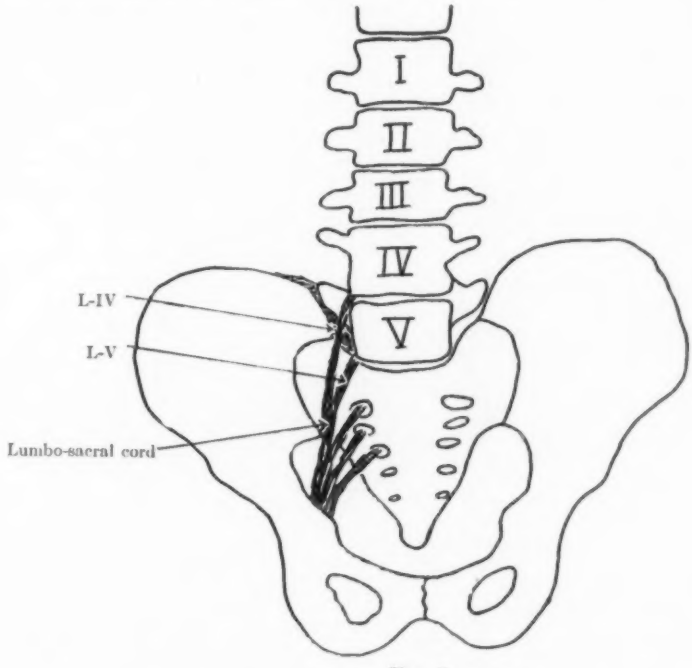


FIG. 8

Drawing from Subject 3. This is the classical arrangement of the lumbo-sacral cord.

Continuing downward, the fifth nerve lay, always in our dissections, well mesial to the sacro-iliac joint, until it reached the great sciatic notch. Here it was usually mesial to the joint, but very close to it, and occasionally lay on the joint.

The first, second, and third sacral nerves were always well away from any possibility of direct contact with the sacro-iliac joint.

The effect of various motions on the foramina and joints may be summarized as follows:

Hyperextension of the spine caused the posterior superior articular facets of the posterior joints to be driven upward toward the inferior intervertebral notches of the vertebra next above, and in this way diminished the size of the intervertebral foramina and might conceivably com-

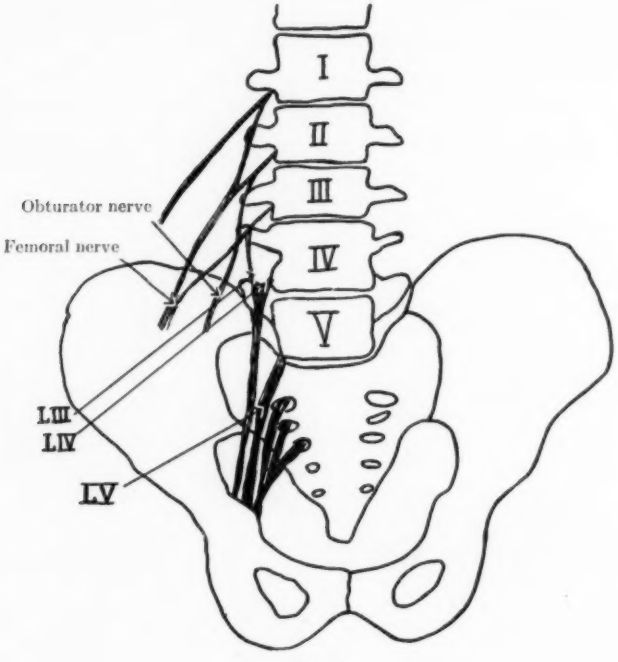


FIG 9

Drawing from Subject 4. Note that here L III contributes to the sciatic nerve. L III and L IV have joined, but L V is entirely separate from them up to its emergence from the pelvis.

press the nerve to some extent. However, in the case of all the roots except the fifth, the relative sizes of the nerve roots to the enclosing canal make this unlikely, but in the case of the fifth it seemed very possible.

Lateral flexion has much the same effect on the posterior articulation on the side toward which flexion is made, while it enlarges the outlet on the opposite side.

Flexion, it seemed, could make no direct pressure on the fifth root except in those cases where there were spurs on the sides of the adjacent articular surfaces of the body of the fifth vertebra and the sacrum. In the two instances where the spurs were present, flexion caused a very distinct diminution in the size of the channel containing the nerve.

Flexion of the thigh with the knee extended causes a definite tightening of the fifth, fourth, and third lumbar roots. Hyperextension of the thigh relaxes these structures. Flexion of the thigh with the knee flexed also appears to relax the nerve roots.

A further point was that in the subjects studied for motion in the sacro-iliac joint, where motion could be demonstrated by manipulation of the thigh, it could also be demonstrated by lateral compression of the two iliac crests.

ANATOMIC CONCLUSIONS

Thus from our dissections it seems fair to say that nerve pain due to joint disturbance, either from position or from actual pathological change in the joints, might occur:

In the fourth root:

First—In its course in the intervertebral canal.

Second—At the lower margin of the sacro-iliac joint at the great sciatic notch.

In the fifth root:

First—In its course in the intervertebral canal.

Second—At the lateral margin of the joint between the fifth lumbar body and the sacrum.

Third—At the lower margin of the sacro-iliac joint.

While it is impossible to state positively the exact point where it may in a given case actually occur, it seems much less likely to occur at the sacro-iliac joint, for there, there is no canal nor semblance of a canal which holds the nerves against the joint. Any distention of the joint could cause apparently only a little lifting up of the nerve, but could not in any way encircle it or exert pressure on it, as the structures of the nerve are too easily displaced. On the other hand, in the lumbo-sacral region, the ligaments holding the fifth lumbar to the ilia and sacrum are very strong and still further narrow the space for the passage of the fifth nerve. Furthermore, the nerve roots in the intervertebral canals between the fourth

and fifth lumbar and between the fifth lumbar and the sacrum are definitely enclosed in bony canals and could easily be irritated by an encroachment on this space from an inflammatory process of arthritic or traumatic origin, or even conceivably mechanically from the position of extreme hyperextension. Our personal conviction from examination of the specimens is that the chances for nerve involvement are much greater in the lumbo-sacral region than in the sacro-iliac region.

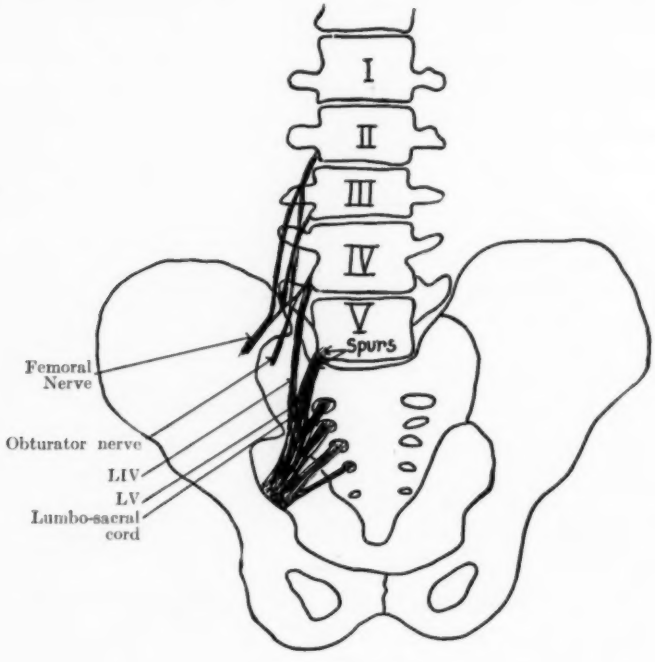


FIG. 10

Drawing from Subject 5. Here L V at its emergence from the intervertebral canal was embedded in a groove formed by an osteophytic outgrowth from the articular margins of the fifth lumbar vertebra and sacrum.

CLINICAL INVESTIGATION

Our clinical investigation consisted of an examination of twenty-one patients at the Massachusetts General Hospital Orthopaedic clinic. Male patients only were chosen, as that made for ease in examination. The only requirement was that they should give a definite complaint of pain

in the distribution of the sciatic nerve, for which on preliminary examination no obvious explanation could be found.

A careful history was first obtained. Then a routine examination of the back and lower extremities was made, followed by a neurologic examination for disturbance in cutaneous sensibility, changes in reflexes, and changes in voluntary power of muscles. Then a roentgenologic examination was made, consisting of stereoscopic films of the lumbar spine and sacro-iliac region in antero-posterior view, and a lateral flat film of the lumbo-sacral region.

Summary of Cases:

Number of patients: 21.

Age: Youngest 24, oldest 58. Average 36.

Occupation: Varied. All on their feet much of time.

Duration: From a few weeks to two years.

Onset: Seven had history of injury—of these three had immediate onset of pain in buttock and hip, gradually working down into thigh. The other four of the seven had gradual onset of the pain. The remaining fourteen of the twenty-one had gradual onset of symptoms. In three of them there was a preliminary attack of pain in the back, while in the others the pain began primarily in the thigh or leg.

Location of pain: Our charts (Figs. 15 to 35 inclusive) show this well. Back pain was, or had been, present in seven cases. The back pain was usually localized in the lower lumbar region on the side of the leg pain. The leg pain was usually deep seated in the buttock, back of hip, and thigh, and corresponded to the course of the sciatic nerve, often associated with tenderness. When it extended below the thigh, as it did in eighteen cases, it was more superficial in character and was localized in well defined areas (see Charts). In three cases the leg pain was described as being deeply situated and not well defined.

Spinal examination: A list was present in nineteen cases (indicated on Charts), fourteen away from the side of pain (*i.e.* crossed type), four towards side of pain (homologous type), and one alternating type. The list was considered a protective mechanism, at least in the crossed type.

Posture: There was usually an increase of the lumbar lordosis over normal. Sometimes there was flattening, and when present this was very striking.

Movements of spine: All cases showed limitation of motion, especially in hyperextension and on lateral flexion in a direction to correct the list.

Flexion was usually sharply limited and painful. The limitation of flexion may be due to stretching of the sciatic nerve which results from this movement.

Tenderness: Two cases showed no tenderness. (The areas of tenderness are shown on the Charts.) Eleven cases showed tenderness over

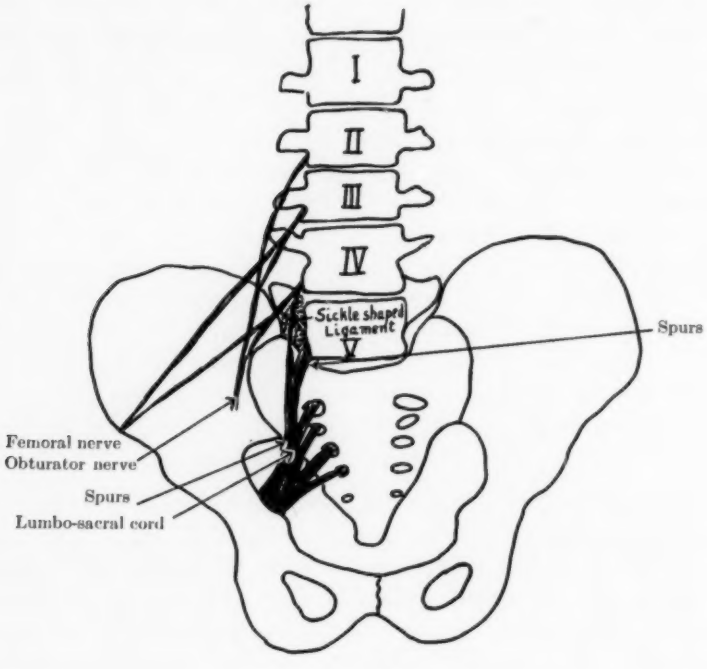


FIG. 11

Drawing from Subject 6. Here, at its emergence from the intervertebral canal, L V was embedded inferiorly in a groove formed by an arthritic spur, and superiorly was closely invested by the margin of a firm ligament.

the posterior lumbo-sacral joint on the affected side. In seven of these eleven cases there was some tenderness over the superior gluteal region. In three cases there was tenderness over the sacro-iliac joint, with none in the lumbar region; but in each of these three cases, however, the point of greatest tenderness was over the superior gluteal region. In eleven cases there was tenderness on pressure over the great sciatic notch.

Compression of the iliac crests in every instance failed to produce pain.

Motion of the hips was occasionally guarded on the affected side, especially in the acute cases.

Lying straight-leg raising, was limited in every case on the affected side. In two cases it was equally limited on the opposite side, but in the other cases it was considerably more free. In almost every case this

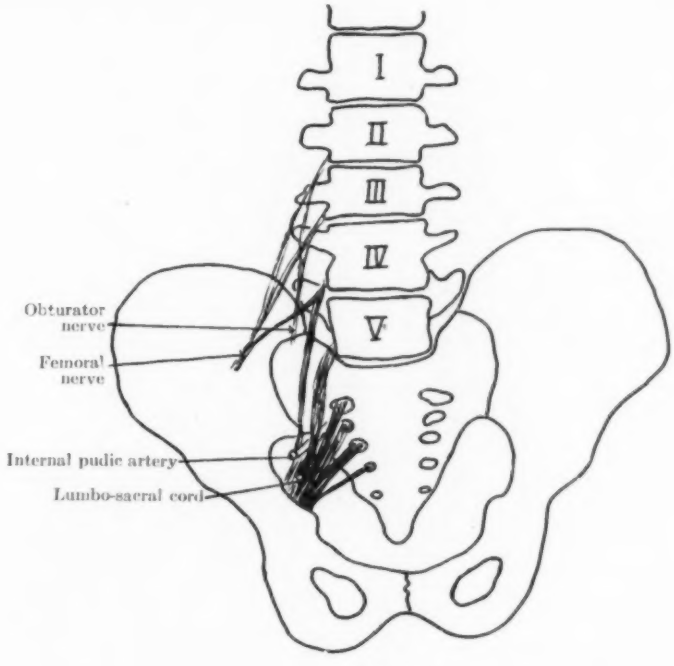


FIG. 12

Drawing from Subject 7. Here the internal pudic artery emerged between L IV and L V in the pelvis and there was no distinct lumbo-sacral cord.

procedure evoked pain somewhere in the course of the sciatic nerve. In two cases elevation of the extended leg on the opposite side also produced pain on the affected side.

Rectal examinations were made in the majority of the cases, and tenderness in the region of the sciatic notch was found in most of the cases so examined. This method of examination does not seem very helpful in differentiation except to exclude intra-pelvic tumors or inflammations

as the cause of trouble. It is impossible to explore more than the inferior margin of the sacro-iliac joint and as the sciatic nerve roots lie between the finger and the joint, the tenderness is more likely due to the pressure on the irritated nerve structures than to a lesion in the joint itself.

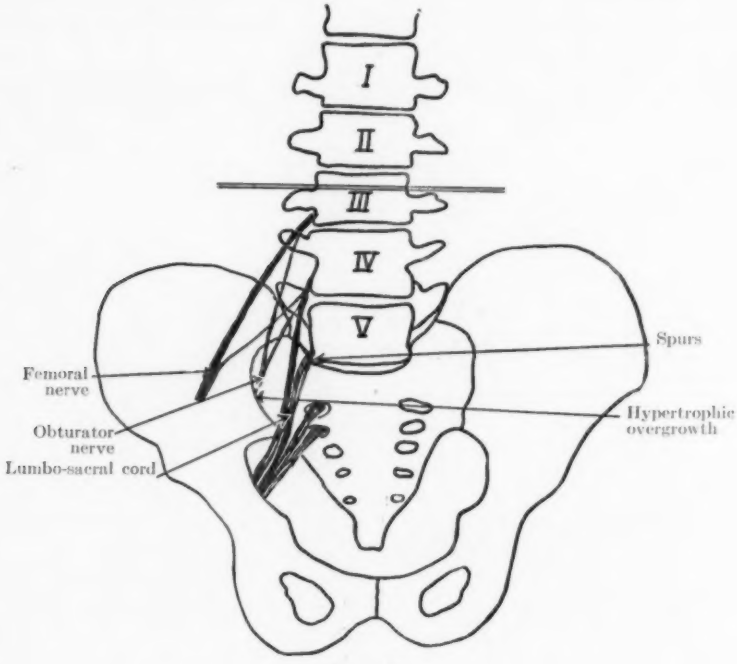


FIG. 13

Drawing from Subject 8. Note the spur formation about the joint between the body of the fifth lumbar and the sacrum and about the sacro-iliac joint.

NEUROLOGIC EXAMINATION

Six cases showed absolutely no objective evidence of nerve involvement. Fifteen showed well marked signs of nerve involvement, three of this number having tenderness as the sole indication. In ten there was either complete absence or diminution of the Achilles reflex. In two the patellar reflex was diminished on the affected side, while the Achilles reflex was normal, but the corresponding abdominal reflex was absent. Nine cases showed areas of disturbed cutaneous sensibility—in six it was diminished, in three it was increased—over varying areas usually centering

over the outer side of the leg or foot. In one case there was distinct motor disturbance with inability to extend the outer two toes. Atrophy was present in nine cases.

The Charts (Figs. 15 to 35) show graphically the associations of pain, list, tenderness, changes in cutaneous sensibility, and changes in reflexes.

Cases 1, 4, 5, 6, 8, and 12 (Figs. 15, 18, 19, 20, 22, and 26) show areas of diminished cutaneous sensibility over the outer side of the leg or foot.

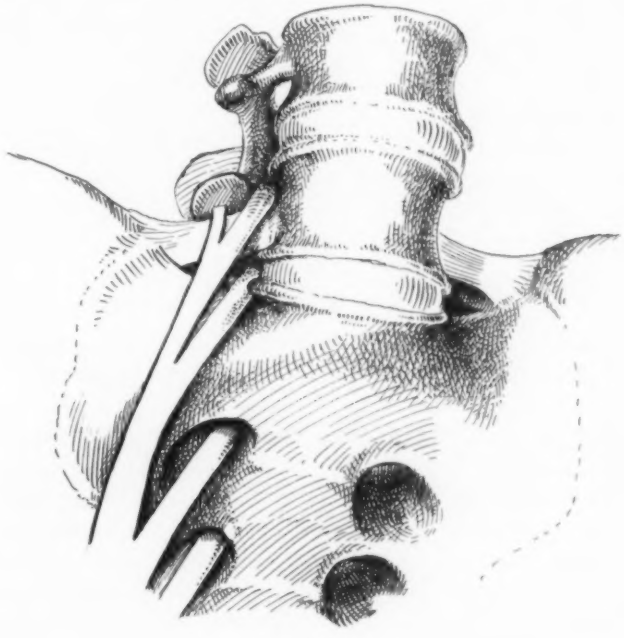


FIG. 14

Drawing from dissection, showing relation of L IV and L V nerves at the lumbo-sacral junction. Note how L V is embedded in a groove formed by an arthritic spur.

Cases 10, 11, and 20 (Figs. 24, 25, and 34) show hyperaesthesia on the outer side of the leg or foot. Cases 3, 8, and 15 (Figs. 17, 22, and 29), had pain on the outer side of the leg or foot. Cases 1, 2, 3, 5, 6, 10, 12, 15, and 20 (Figs. 15, 16, 17, 19, 20, 24, 26, 29, and 34) had diminished or absent Achilles reflex on that side, so that of those with diminished or absent Achilles reflex all except 2 and 13 (Figs. 16 and 27) had changes in cutaneous sensibility or pain over the outer side of the leg or foot.

While there is much variation of opinion as to the spinal localization of the Achilles reflex, all but one of the authorities noted in List II agree that the fifth lumbar plays a part, and Figs. 36 A, B, C, D and E show that most authorities agree that the fifth lumbar plays a part in the cutaneous innervation of the skin on the outer side of the leg.

LIST II

Chart Showing the Spinal Localization of the Centres for the Achilles, Patellar, and Plantar Reflexes, According to Different Authors.

Achilles Reflex:

Babinski—L. V., S. I.
Purves Stuart—S. I., S. II.
Oppenheim—L. V., S. I.
Kraus—L. V., S. I., S. II.

Patellar Reflex:

Jelliffe and White—L. III., L. IV.
Purves Stuart—L. III., L. IV.
Oppenheim—L. II., L. III., L. IV.
Kraus—L. III.

Plantar Reflex:

Oppenheim—S. I., S. II.

It seems to us therefore that both from the neurologic examinations and from the distribution of the pain, involvement of the fifth lumbar is suggested.

Roentgenologic examinations were made in all cases, but in two the films have been lost.

Of the nineteen cases studied, twelve showed definite gross changes in the fifth lumbar, of which three were of a developmental nature and nine represented definite pathology. In the thirteenth case there was definite pathology in the fourth lumbar, probably early tuberculosis. In the fourteenth case there was definite pathology of the third and fourth lumbar bodies, and the clinical picture was of a high lesion, as evidenced by loss of abdominal reflex, while the patellar reflex was increased and the Achilles reflex normal. In three cases there was tilting of the fifth on the sacrum, without other apparent pathology. In two cases the films were negative, except that one showed a very flat lumbo-sacral junction, while the other showed a questionable haziness in the sacro-iliac joint on the side away from the pain. In none of the roentgenograms was there evidence of involvement of the sacro-iliac joints, except in one showing extensive hypertrophic changes in the entire lower spine, in one where a questionable irregularity was noted by us but not reported by the roentgenologist, and in the one, above discussed, of a questionable haziness in the opposite sacro-iliac joint.

CONCLUSIONS

The clinical examinations of the backs show that in all these cases there was evidence of disturbance in the region of the lower lumbar spine. In the majority of the cases this was substantiated by roentgenologic examination.

Clinical evidence of nerve involvement was found in over half the cases. (Actually in fifteen out of twenty-one.) In many of the cases signs were present which helped to localize the portion of the nerve affected.

The areas of anaesthesia or hyperaesthesia, the changes in the reflexes, and the points of tenderness suggest either the fourth or fifth lumbar roots and the first and second sacral roots as the ones involved. (See Charts.)

The anatomic studies in our opinion show that changes occurring at the lumbo-sacral junction have the greatest possibility of affecting nerve structures. Conditions existing in the intervertebral canal between the fourth and fifth make that the next most likely point for nerve involvement. The solid nature of the sacrum offers little possibility for involvement of the sacral nerves during their exit, and the subsequent course of these nerves is such as to render their involvement unlikely.

We have approached the subject of sciatic pain from four different standpoints: first, anatomical dissections; second, clinical examination of the spine; third, neurologic examination for localizing evidence; and fourth, roentgenologic examination. It seems to us that the evidence obtained in all the investigations indicates that sciatic pain of the type studied is a symptom of disturbance in the lower lumbar spine and that the site of the lesion is most frequently the lumbo-sacral junction, and the nerve chiefly involved is the fifth lumbar.

CASE REPORTS

CASE 1. L. A. Age 36. Occupation: grocery store proprietor.

P. I.: Three months ago foot caught while he was going downstairs and he wrenched his back. Severe pain in left lumbar region for one week; then as it was clearing up, began to have pain running down back of left thigh, leg, and into foot, affecting outer two toes.

P. E.: Stout man with large abdomen. Stands without list, but with increased lumbar lordosis.

Spinal Movements: Forward bending much limited and causes pain in left sacro-sciatic notch. With it there is a fairly marked list to the left (affected side). Backward bending is a little limited and painful. Lateral bending is limited, less to left than to right. Spasm is noted in the muscles to the left of the lumbar spine.

Straight Leg Raising: On *left* to 60 degrees, where sharp pain is caused at sciatic notch. On *right* to 90 degrees, painless.

Pain, Tenderness and Neurologic Examination as per diagram.

Wassermann: Blood negative; spinal fluid, weakly positive.

Spinal Fluid: Cell count, 5. Butyric Acid, 25. Gold Solution, 0000000. T. P., 20.4.

Roentgenologic Examination. No. 80727: Shows a slight tilt of the fifth lumbar vertebra to the left side, with slight rotation of the body to the right, making the spinous process lie slightly to the left. The posterior articulation on the left cannot be seen. Lateral view shows slight hypertrophic lipping of the ninth and tenth dorsal vertebrae.

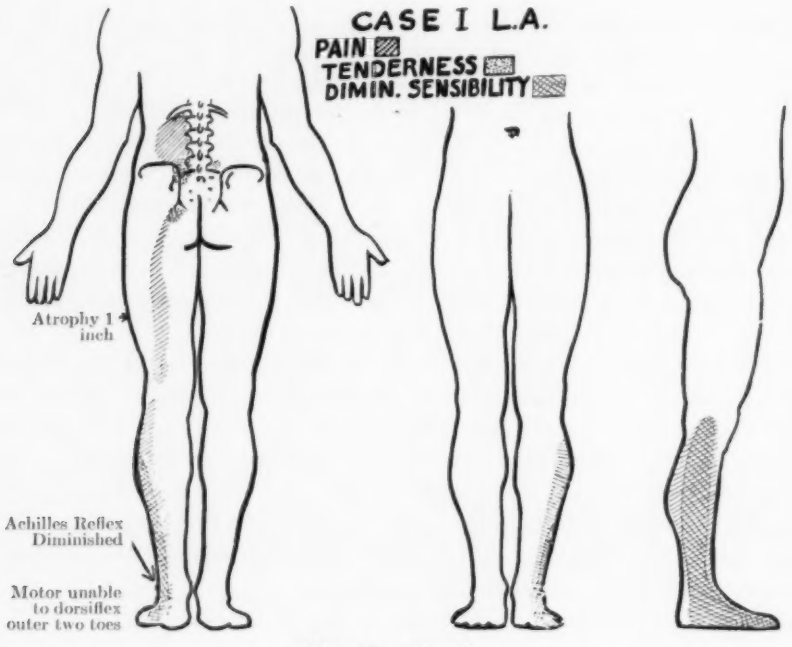


FIG. 15. CASE I

CASE 2. A. B. Age 46. Occupation: saw operator in sawmill.

P. I.: One week ago began to have aching pain in the left hip, running down into the left ankle. Gradual onset, without previous history of trauma or acute infection. Pain has been severe enough to interfere with sleep.

Recurrence: About twelve years ago had a somewhat similar attack lasting two to three weeks, affecting the same leg.

P. H.: Always well. Denies venereal.

Examination: General posture very bad. *List:* Marked total list to right. *Movements of Spine:* Hyperextension slightly limited, but painless. Flexion increases list to the right and is limited at about 60 degrees. It causes pain in left buttock. Side bending to the right is more free than to the left. In both movements the lumbar spine is held stiffly.

Straight Leg Raising: On the *right* to 90 degrees. On the *left* it is limited at 70 degrees, but does not cause pain.

Pain, Tenderness, and Neurologic Examination: See chart.

Roentgenologic Examination: Shows a beak-like projection on the left side of the spine, caused by overgrowth of the inferior margin of the fourth lumbar and the superior margin of the fifth lumbar vertebrae. No other change is seen in the spine, and it is a question whether this is not the result of trauma or an old osteomyelitis.

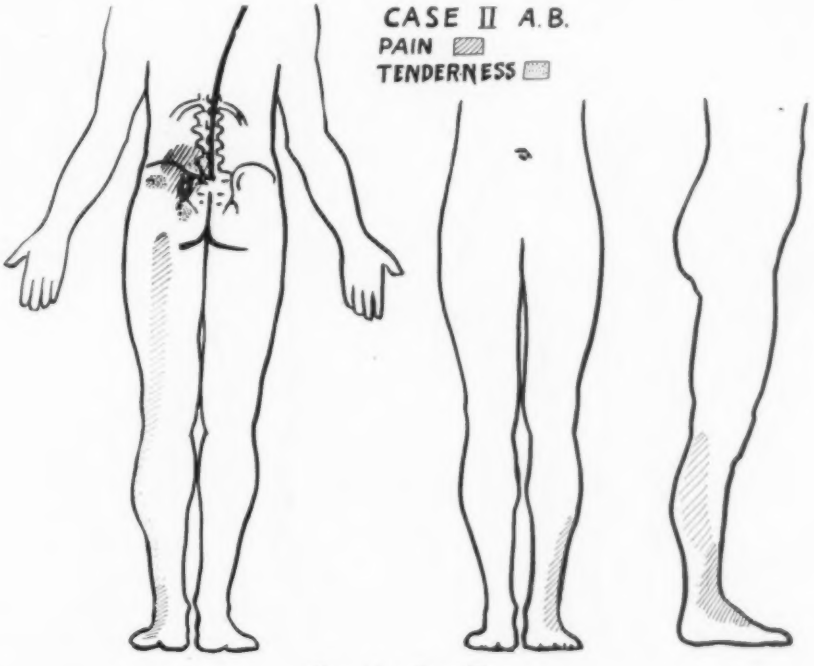


FIG. 16. CASE II

CASE 3. W. B. No. 487159 O. P. D. Age 39. Occupation: shipyard riveter.

P. I.: Gradual onset of pain six months ago. Located over course of sciatic nerve on *left* side, from buttock to outer side of ankle. Any exercise or stooping causes much pain. Almost no pain when in bed. Getting worse.

Examination: Faulty posture with increase in lumbar lordosis. List of spine to *right*.

Spinal Movements: Forward bending much limited and guarded. Backward bending also limited and guarded. Side bending to left almost nil. Side bending to right only slightly limited.

Lying Straight Leg Raising: On *right* 60 degrees and causes a little pain in left thigh. On *left* to 40 degrees and causes pain in left thigh.

For Pain, Tenderness, and Neurologic Examination: See chart.

Roentgenologic Examination shows a very acute angle in the lateral plane at the lumbo-sacral junction, with sharpening of the apices of the posterior articular facets of the fifth lumbar and the sacrum.

CASE 4. T. B. Age 44. Occupation: machinist.

P. I.: Seven weeks ago began to have severe pain in the lower right side of the back. At the time of onset was at work and was lifting a heavy mould onto a bench. Worked remainder of day, and following morning was again caught with severe pain in back.

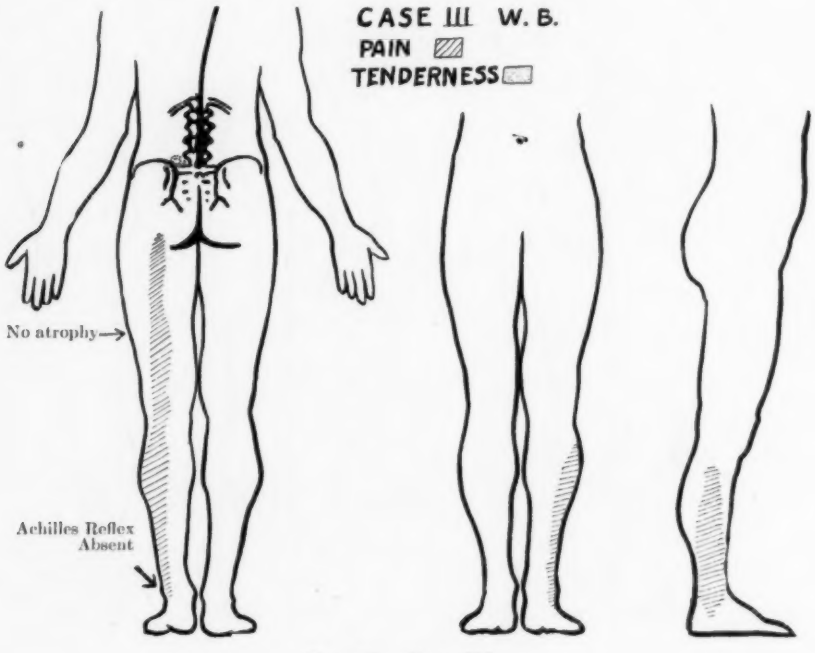


FIG. 17. CASE III

Following day couldn't get out of bed and remained there for more than one week. At this time pain began running down back of thigh and later into ankle and foot. Lying is most comfortable, sitting is least, walking is fairly easy.

Examination: No definite list; slight left lateral curve. Lumbar lordosis about normal, except upper trunk is thrown back in relation to pelvis.

Spinal Movements: Forward bending much limited and causes pain behind right knee. Hyperextension much limited and causes pain in back of right thigh. Side bending to left limited but symmetrical curve.

Lying Straight Leg Raising: On *right* to 45 degrees and causes pain in back of thigh. On left to 60 degrees, painless.

For Pain, Tenderness, and Neurologic Examination: See chart.

Roentgenologic Examination: The fifth lumbar is symmetrically placed on the sacrum. The transverse process on the right is larger than on the left and may impinge upon the sacrum. The apparent space between the transverse process and the sacrum on the right is definitely less than on the left. No other changes made out, except at one point in the right sacro-iliac joint there is a questionable irregularity for about three-quarters of an inch. (Not reported by the Roentgenologist.)

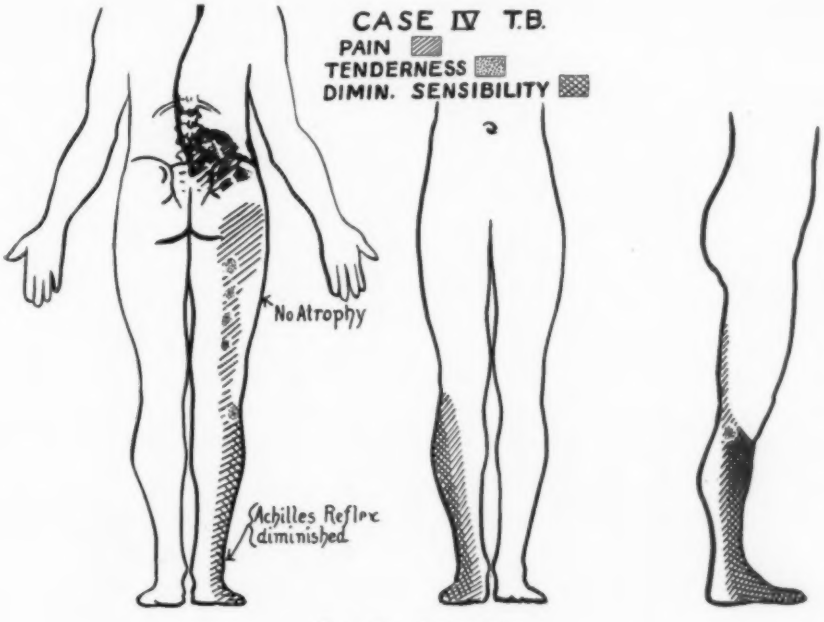


FIG. 18. CASE IV

CASE 5. W. H. P. Age 45. Occupation: roofer.

P. I.: Began eleven months ago to have pain along outer side of left thigh, outer side of leg and ankle, and some across lower part of back. Several months ago pain shifted to right thigh and leg, and one night he was awakened by sharp pain in right ankle. The following morning it had changed back to the left leg and has remained there, but right foot seems numb while walking, although there is no pain. Has never had pain in both legs at same time. Says after stooping it takes some time to straighten up. Pain in outer side of the left thigh and leg is of a grinding character. Standing brings on pain, which disappears when he lies down. History of preceding abrasion of left ankle and of exposure, to which he attributes onset.

Examination: The lumbo-sacral lordosis appears flatter than normal. *List:* Spine shows total list to left, but patient says the body is sometimes thrown to right, sometimes to left.

Spinal Movements: Forward bending is limited in lumbar spine but does not cause pain. Hyperextension is almost nil and shoots pain down left thigh. Lateral bending to right is nil. Lateral bending to left is less limited but occurs chiefly above the third lumbar. Very definite spasm of muscles at right of lumbar spine.

Lying Straight Leg Raising: On *right* to 50 degrees; on *left* to 60 degrees.

For Pain, Tenderness, and Neurologic Examination: See chart.

Roentgenologic Examination: No. 101772. The sacro-iliac joints are normal. The relation of the fifth lumbar vertebra to the sacrum is normal and its posterior articulations are normal. The transverse processes of the fifth lumbar are large, but show no

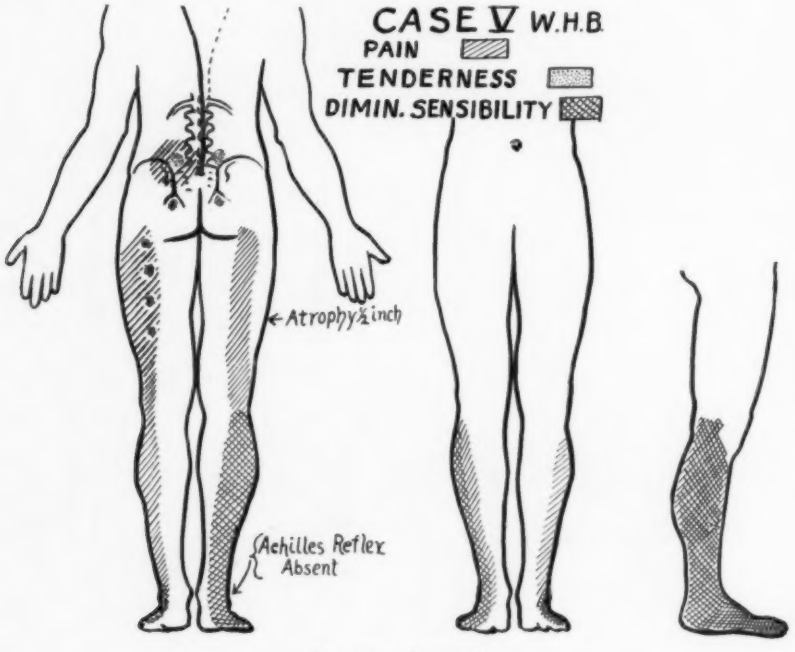


FIG. 19. CASE V

evidence of impingement. The body of the fourth lumbar is tilted downward on the left side. There is a well defined hypertrophic spur on the adjacent bodies of the fourth and fifth lumbar on the left. Slight hypertrophic changes on left side of the adjacent margins of the second and third dorsal. The lateral view shows a rather flat lumbosacral angle, with slight lipping between the fourth and fifth lumbar vertebrae.

CASE 6. J. H. C. Age 41. Occupation: laborer.

P. I.: About ten days ago developed pain in left side of left back. This came on five to six hours after lifting a heavy barrel (75 lbs.). Within a few days pain began working down left leg and is now localized on the outer surface of the lower leg in the

lower third and about the external malleolus. Now has no pain in back. Pain is relieved by lying or sitting and is made worse by standing.

Previous Attacks: Patient has had previous attacks of a similar nature, always affecting the left leg, in 1916, 1918 and 1920. Always the pain came on after doing some heavy laboring work. After a period of four to six weeks the pain would disappear.

Examination: Stout man, with heavy abdomen. *List:* Spine inclined slightly to right. Increased lumbar lordosis.

Spinal Movements: Forward bending free and painless. Hyperextension much limited, especially in lumbo-sacral region. Lateral bending to right a little limited;

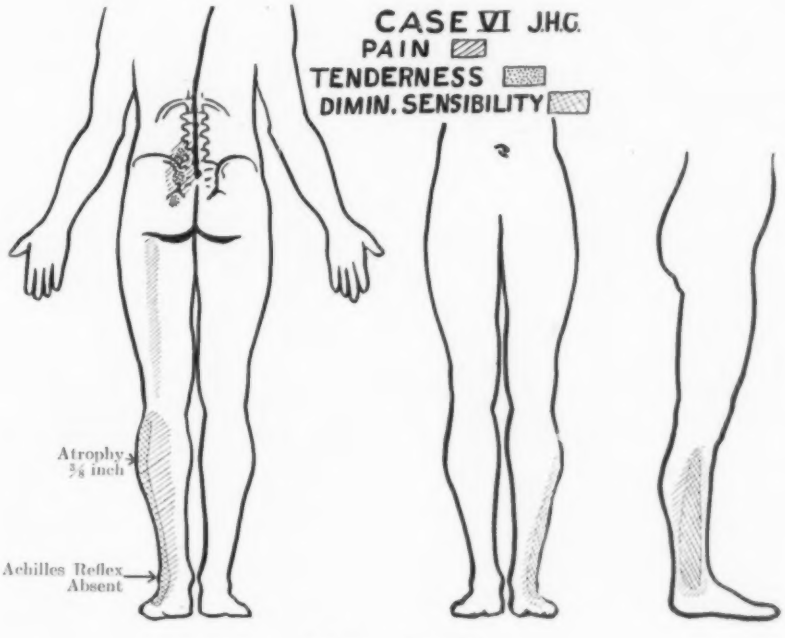


FIG. 20. CASE VI

to left, more limited and takes place at a higher level. Very distinct spasm of muscles to left of lumbar spine.

Lying Straight Leg Raising: On *left* to 45 degrees; on *right* to 60 degrees.

For Pain, Tenderness and Neurologic Examination: See charts.

Roentgenologic Examination: There is a slight tilt of the spine to the right, beginning at the lumbo-sacral junction. There is questionable evidence of an hypertrophic change in the fifth lumbar vertebra. The transverse processes of the fifth lumbar are of medium size and slender and show no possibility of impingement.

CASE 7. M. C. Age 51. Occupation: steam driller.

P. I.: Three months ago, while putting up a steam drill, felt something pull in back, and then began to have pain in the region of the left great trochanter. Pain ran down the outer side of the thigh and into the calf of leg. No previous attacks.

Examination: In standing position, the back shows an increase in dorsal kyphosis and a well marked lumbar lordosis. *List:* None; but left shoulder is a little lower than right.

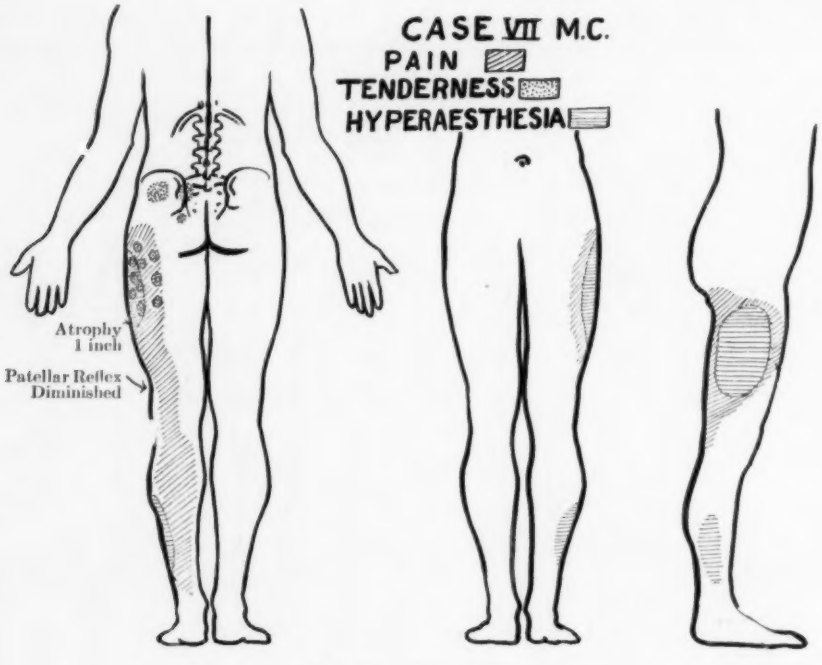


FIG. 21. CASE VII

Movements of Spine: Forward bending markedly limited. Backward bending almost nil. Both are painless. Lateral bending to right markedly limited; to left slightly less limited. There is spasm in the muscles at the left of the lumbar spine; none on the right.

Movements of Hips: Both show slight limitation of movement, about equal in all directions.

Lying Straight Leg Raising: On *left* to 45 degrees; on *right* to 60 degrees.

Pain, Tenderness and Neurologic Examination: See chart.

Roentgenologic Examination: Shows considerable osteo-arthritic involvement of the entire lumbar spine and a large projecting spur from the inferior margin of the third lumbar vertebra on the right side. There is considerable involvement by the same process of the posterior articular facets, which on the left side between the fifth lumbar

and the sacrum and between the fourth and fifth lumbar are built up sharply and irregularly on the lateral margins. The sacrum is deep-set, and the transverse processes of the fifth lumbar extend outward in close proximity to the iliac crests, but apparently there is no true articulation here. The spine is inclined slightly to the left beginning at the sacrum, and at the junction between the second and third lumbar there is a sharp deviation to the right. The sacro-iliac joints are hazy, with increased density, suggesting partial obliteration. There is a small spur at the inferior margin of each joint.

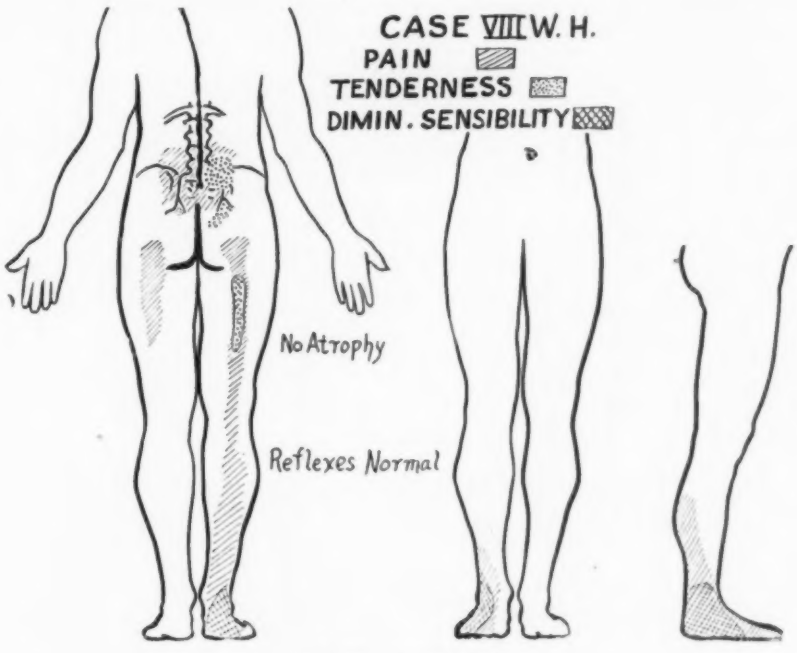


FIG. 22. CASE VIII

CASE 8. W. H. Age 30. Occupation: cold storage warehouse shipper.

P. I.: About eight weeks ago first developed pain in middle of low back. Came on gradually for two to three days and then became worse when he caught cold. Stayed home in bed for one week. No fever, but coughed considerably. Pain was then somewhat easier and he went back to work. Two weeks after onset the pain began to work down into right leg (see chart), and at the end of three weeks had become so severe that he had to stop work. Foot feels numb and cold. Pain is constant, but is easier when recumbent. No previous attacks. General health always good.

Examination: Antero-posterior curves of the spine are moderately increased. *List:* Spine is inclined to left.

Spinal Movements: Forward bending almost nil; as likewise hyperextension. Side bending to right is limited and occurs chiefly at dorso-lumbar junction. Side

bending to left takes place at a lower level, but is even more limited. Marked spasm of right lumbar muscles.

Lying Straight Leg Raising: On *right* to 30 degrees, where it is absolutely limited and causes pain at right gluteal fold near tuberosity of ischium. On *left*, to 45 to 50 degrees, at which point it causes pain at above point on right side.

For Pain, Tenderness and Neurologic Examination: See chart.

Roentgenologic Examination: The body of the fifth lumbar vertebra is somewhat irregular, and the vertical diameter on the left side is definitely less than that on the right side, so that the spine above is tilted to the left. The posterior lumbo-sacral articulations are not clearly shown, but suggest possibility of some thickening of the

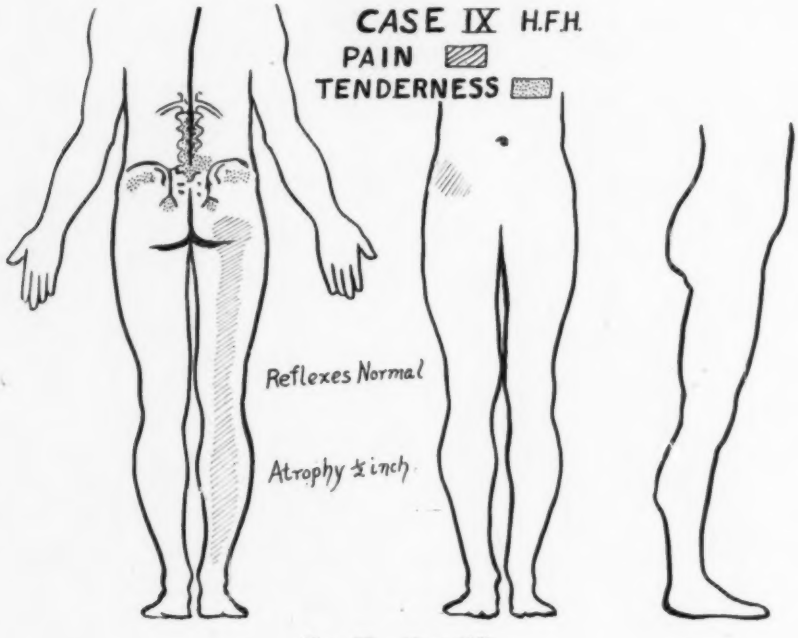


FIG. 23. CASE IX

facets. The transverse processes of the fifth lumbar are of medium size, but on the left side it may articulate with the sacrum. The point of insertion of the ilio-lumbar ligament on the left side is raised and there is a narrow shadow running from this point to the fifth transverse process on that side. The left hip joint appears normal, but on the right there is definite lipping on the inferior margin of the acetabulum.

CASE 9. H. F. H. Age 29. Occupation: machinist.

P. I.: About five months ago, following a three weeks vacation, during which he had a good deal of active exercise, began to have shooting pain down back of right thigh, popliteal space, and calf of leg. This has been associated with some lameness in the lower back, more on the right than on the left. Occasionally a headache and

pain radiating forward in flanks, between rib margins and iliac crests. The leg pain is growing worse, but is relieved by lying down. General health always good.

Examination. Posture: Dorsal and lumbar curves appear definitely flattened. *List:* Slight inclination of spine to right. No kyphos.

Spinal Movements: Forward bending almost nil and causes no special pain. Backward bending nil in lumbar spine, but painless. Lateral bending to left very much limited and occurs with angular bend at the third lumbar. Lateral bending to right is slightly less limited and appears more regular. Noticeable spasm of both muscle columns; more on right.

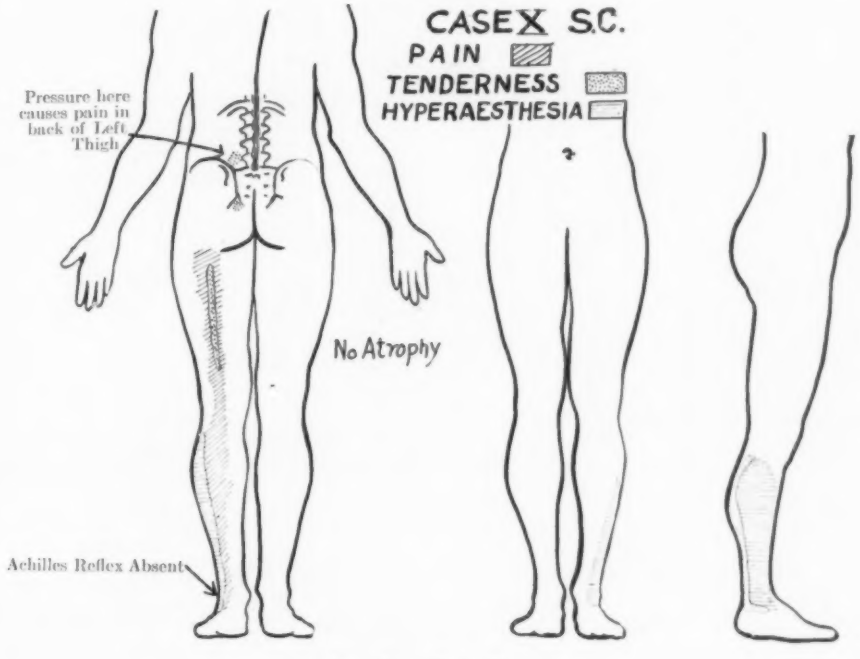


FIG. 24. CASE X

Lying Straight Leg Raising: On *right* to 45 degrees, where it causes a little pain in right buttock. On *left* to 60 degrees, and is painless.

For Pain, Tenderness and Neurologic Examination: See charts.

Roentgenologic Examination: Shows the lumbar spine listed slightly to the right. The space between the fifth lumbar and the top of the sacrum is narrow and irregular. Also the space between the bodies of the fourth and fifth lumbar vertebrae is indistinct and irregular. The lateral view shows rarefaction of the body of the fourth lumbar, and the appearance suggests that the vertical diameter at the posterior margin of the fifth lumbar is less than the vertical diameter at the anterior margin.

Roentgenologist's Report says, referring to the process in the fourth lumbar, "It appears to be accompanied both by destruction and proliferation and maybe a tuberculous process in one of the lateral masses or other infectious condition."

CASE 10. S. G. No. 82403. Age 25. Occupation: fruit peddler.

P. I.: Eleven months ago, without history of trauma or acute infection, gradually developed pain in left thigh and calf. This has hung on steadily, at times with exacerbations, but he has usually been able to continue with his work. Recently it has been getting worse.

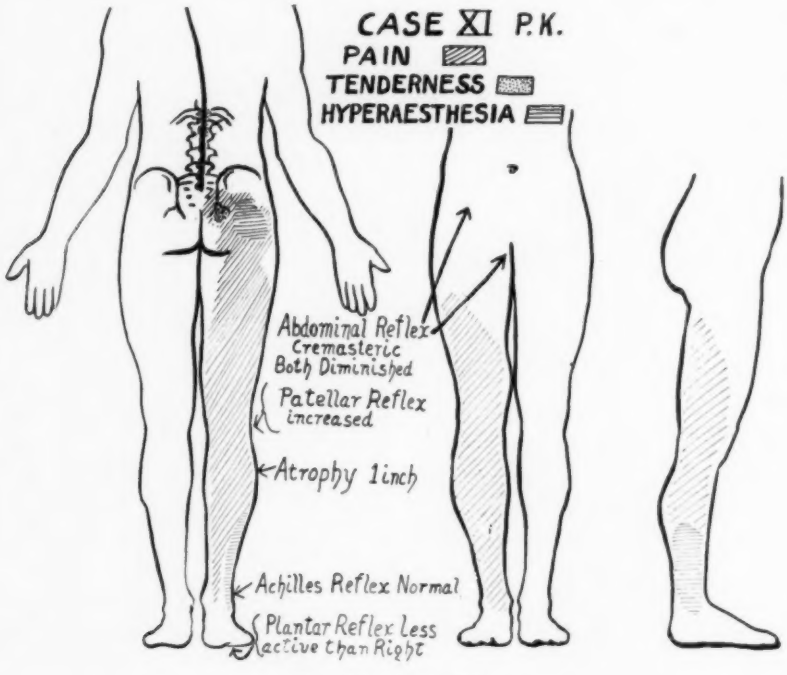


FIG. 25. CASE XI

Examination: Short, very stout man; abdomen large and prominent; bad posture. *List:* Spine is inclined to right.

Spinal Movements: Forward bending much limited and guarded. Causes pain in back of left thigh. Backward bending limited but painless. Side bending to right free and painless. Side bending to left fairly free and painless, but to left causes some pain in back of left thigh.

Lying Straight Leg Raising: On left to 25 to 30 degrees; on right to 45 to 50 degrees. Each causes sharp pain in back of left thigh.

For Pain, Tenderness and Neurologic Examination: See chart.

Roentgenologic Examination: The spine is tilted very definitely to the right, beginning very slightly between the fifth lumbar and the sacrum and increasing markedly between the fourth and fifth lumbar. The transverse processes of the fifth lumbar are of medium size and show no possibility of impingement on either sacrum or ilium. The lumbo-sacral angle appears flattened. No evidence of osteo-arthritic change or of irregularity of the bodies.

CASE 11. P. K. Age 58. Occupation: lumper on coal train.

P. I.: In October, 1923, five months ago, first developed pain in lower right side of back and running down thigh into leg. At the time was convalescing from an acute osteomyelitis of the radius and ulna, with infection of the wrist joint, which had crippled him for about one year. This trouble appeared in October, 1922, and he was under treatment continuously during that time in the Massachusetts General Hospital, either as an in-patient or out-patient. Had two drainage operations, the last one in January, 1923. In the summer of 1923, the wrist was manipulated and a flexion deformity corrected. Had just gone back to work in a harness shop when the present trouble made its appearance. The back pain and the leg pain came on simultaneously and gradually. Soon the body became listed and he could not stand erect. An abdominal belt was applied without much relief, and finally about February 1 a plaster jacket was applied, with very considerable relief. Now states that pain is not felt when lying or sitting, but only when walking or standing. Bowels regular. Urination normal.

Examination: Stout man (weight, 200 lbs.). *List:* Spine shows marked list to left, with a slight compensatory curve to right in upper thoracic region.

Spinal Movements: Forward bending markedly limited. Backward bending nil. Lateral bending to right nil and causes pain across upper right gluteal region just below iliac crest. Lateral bending to left almost nil.

Movements of Hips: Both hips show distinct but slight limitation of motion, especially on abduction, internal rotation, and hyperextension.

Knees: Normal range of movement. No thickening or pain.

Feet: Inversion and eversion slightly limited on right foot; otherwise negative.

Fingers: Well developed thickening of all terminal joints of fingers. (Heberden's nodes.)

Lying Straight Leg Raising: On right to 60 degrees and painful. On left to 60 degrees, but is painless.

For Pain, Tenderness, and Neurologic Examination: See chart.

Roentgenologic Examination: No. 90337. Shows very definite hypertrophic changes at the adjacent margins of the articular surfaces of the third and fourth lumbar vertebrae on the right side. There are also less marked but very distinct hypertrophic changes at the adjacent margins of the articular surfaces of fourth and fifth lumbar vertebrae on the left (unaffected side).

CASE 12. C. L. Age 30. Occupation: boiler maker.

P. I.: About one year ago, without history of preceding trauma or infection, began to have pain at the back of the right knee, then in calf and ankle, and still later in lower right side of back. The back pain is the worst now. For past three weeks has been unable to stand erect. Trouble has been growing worse but patient has been able to work until one week ago. Pain is better when lying and is aggravated by sitting and standing.

Examination: Well developed, muscular; evidently suffering. *List:* Spine shows a very distinct deviation to left in lower lumbar region, with a compensatory curve above to the right. *Posture:* A slight rounded dorsal kyphosis with a rather flat lumbar curve and slight prominence of the spinous process of the third lumbar. Body mechanics poor.

Spinal Movements: Forward bending is markedly limited and causes pain at right sciatic notch and in back of right knee. Backward bending is nil. Lateral bending to right is moderately limited and causes pain in popliteal space and in calf. Lateral bending to left moderately limited and causes pain in right sacro-iliac region.

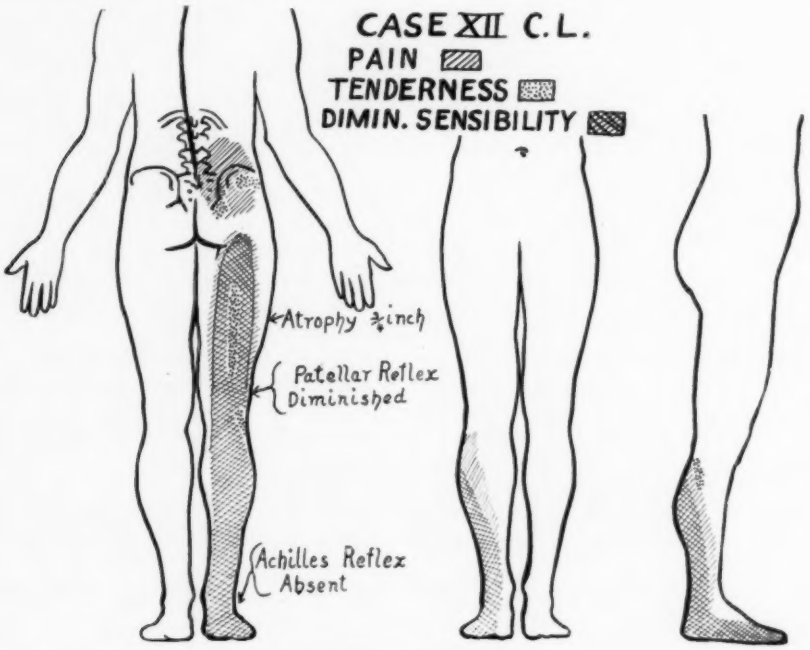


FIG. 26. CASE XII

Straight Leg Raising: On *right* to 35 degrees, with pain in back of right thigh; on left to 80 degrees, without pain.

For Pain, Tenderness, and Neurologic Examination: See chart.

Roentgenologic Examination: Shows a slightly abnormal position of the fifth lumbar in relation to the sacrum. The body of the fourth lumbar is apparently tilted to the left. There is a little rotation of all the lumbar vertebrae, so that the spinous processes are displaced slightly to the left. The lateral view shows a very obtuse lumbo-sacral angle with apparently a little increase in density of the anterior ligament between the fifth lumbar and the sacrum, and a little lipping of the anterior margin of the superior surface of the fifth lumbar.

Case 13. J. McD. Age 30. Occupation: Navy Yard employee.

P. I.: Two and a half years ago fell 35 feet, striking on side (does not know which). Was sent home. Had pain in left flank. In bed for about one week and did not return to work for ten weeks. Since he has returned to work the back has been weak, especially if he tried to lift anything, but he has worked practically all the time. About six weeks ago began to have pain in right calf, then in back of knee, later in back of thigh and buttock. Pain is not felt when in bed, but is severe when he gets up after resting. Is made worse by coughing and sneezing.

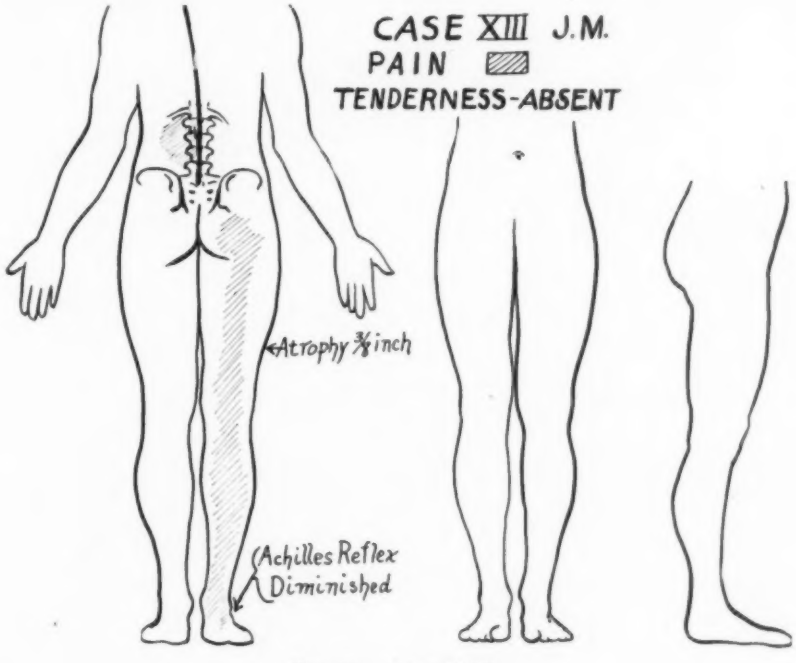


Fig. 27. Case XIII

P. H.: Negative. Denies gonococcus infection, but says he has a slight urethral discharge. (Morning drop.)

Examination. Well developed, muscular. *List:* Spine shows a slight list to left with compensatory dorsal curve to right. *Posture:* The normal dorsal kyphosis and lumbar lordosis are increased. Abdomen moderately relaxed and prominent.

Spinal Movements: Forward bending markedly limited and causes pain about head of right fibula. Backward bending is free. Lateral bending to right occurs at much higher level than lateral bending to left. Neither causes pain.

Lying Straight Leg Raising: On *right* to 60 degrees, and causes pain in back of right calf; on *left* to 70 degrees, where it causes pain in lower part of right buttock.

For Pain, Tenderness and Neurologic Examination: See chart.

Roentgenologic Examination: No. 80722. Shows a wedge-shaped fifth lumbar vertebra, the narrowest part of the wedge being to the right. There is some rotation of the lumbar vertebrae so that the spinous process is displaced to the right.

Case 14. E. P. Age 40. Occupation: tailor.

P. I.: Patient states that about one year ago he had a quinsy sore throat. An abscess in the throat was opened. Was ill seven or eight weeks. When he began to walk, pain developed in the region of the right ankle, and it then started to go up into leg and thigh and hip. There has been no pain in back or sacro-iliac region. Pain has continued off and on for eleven months, but has never entirely disappeared.

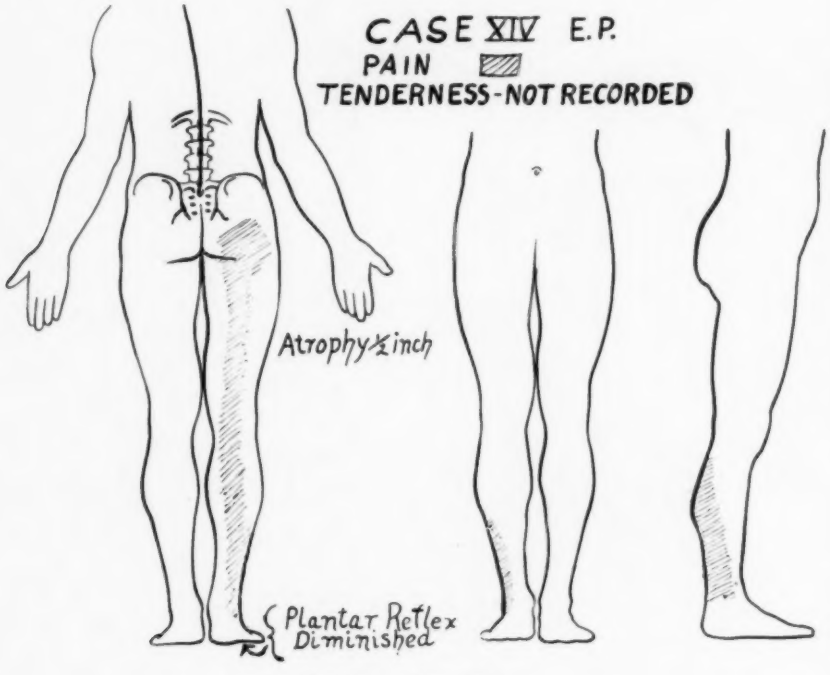


Fig. 28. Case XIV

Examination. Posture: Abdomen a little prominent. Upper trunk thrown back moderately in relation to pelvis. *List:* Spine is inclined moderately to left.

Spinal Movements: Backward bending is moderately limited. Lateral bending to left is slightly limited and painless. Lateral bending to right is a little more limited and causes pain in back of right thigh. Forward bending is moderately limited and causes pain in back of right thigh.

Lying Straight Leg Raising: On *left* to 90 degrees, without pain; on *right* to 70 degrees, where it causes considerable pain in outer part of right hip and back of thigh.

Roentgenologic Examination: No. 101452. Shows a rather low-set sacrum with apparently normal sacro-iliac joints. The fifth lumbar is symmetrically placed on the sacrum. The transverse processes are large and may impinge on the sacrum. The posterior articulations do not appear abnormal. There is no evidence of any arthritic process.

CASE 15. S. P. Age 37.

P. I.: Entirely well until ten years ago when he developed sharp pain in the outer side of the right leg. Attack lasted about one month and subsequently the leg felt numb for nearly a year. At times during ensuing years had a little pain, usually noted

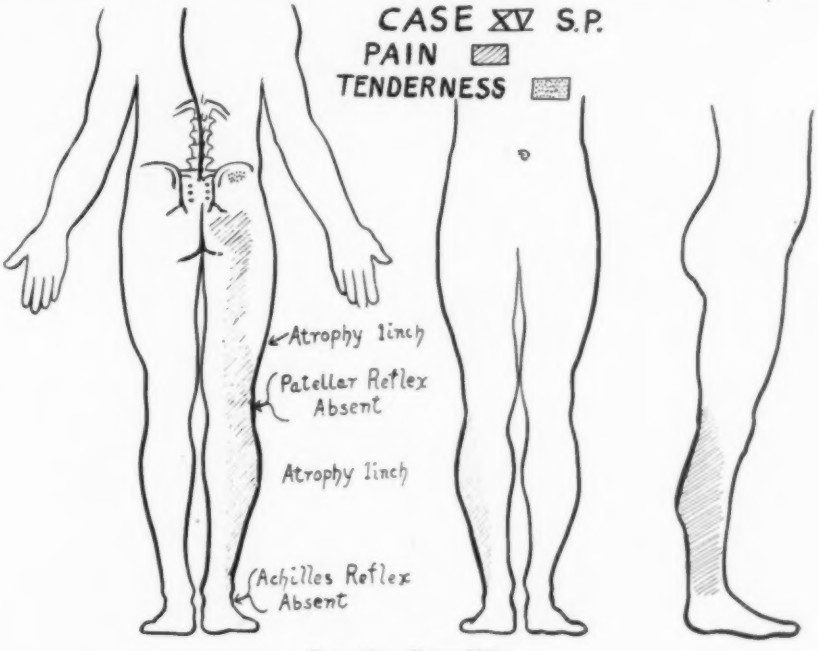


FIG. 29. CASE XV

when he was fatigued. No pain at night. About two years ago began to have pain in the right hip and has been unable to work since. Pain is localized in buttock and in the outer side of the leg. Not improving. Pain is bad when in bed, also when lying.

Examination: List: Spine is deviated to left in lower lumbar region with compensatory curve above to right.

Spinal Movements: The patient cannot stand, so that careful analysis is not possible. All movements seem markedly limited from what can be seen.

Lying Straight Leg Raising: On *right* to 40 degrees, where it causes pain in right buttock. On *left* to 80 degrees, without pain.

Rectal Examination: Negative.

For Pain, Tenderness, and Neurologic Examination: See chart.

Roentgenologic Examination: Shows only slight change in the relation of the fifth lumbar vertebra to the sacrum, the body being tilted to the right. It is otherwise negative.

Case 16. J. L. R. Age 28. Occupation: delivery clerk.

P. I.: About three months ago, without preceding history of trauma or acute infection, patient began to have pain in left calf and buttock. This was relieved temporarily by a back strapping but then grew worse and is now so severe that he has been able to do only inside work. Pain in the buttock is the worst and is made worse when he moves about or sits. As a rule, the nights are comfortable. There has been no pain in the back.

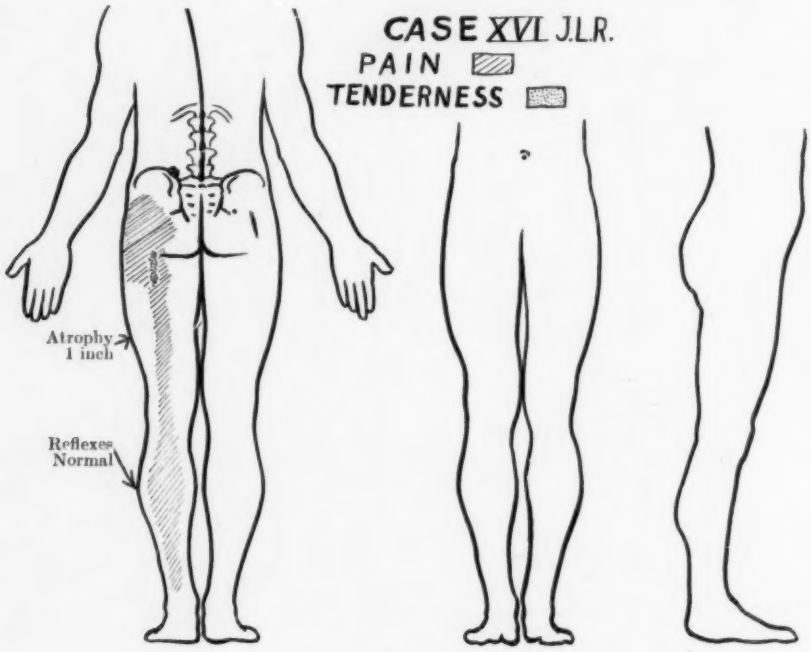


Fig. 30. Case XVI

Examination: Slender, well muscled. *List:* There is a slight but definite list of the entire spine to the left.

Spinal Movements: Forward bending is sharply limited at about 30 degrees flexion. It is accompanied by an increase of the list to the left. Side bending to the left is fairly free, but causes pain in the left buttock. Side bending to the right is much more limited and occurs chiefly at the dorso-lumbar junction.

Straight Leg Raising: On the *left* this is limited at about 35 degrees, and causes pain in the left buttock. On the *right*, the leg may be raised nearly to 90 degrees, but causes

pain in the left buttock when passing a point at about 45 degrees. Further than this the spasm and pain disappear.

Rectal Examination: Slight tenderness on the right side, high up.

For Pain, Tenderness, and Neurologic Examination: See chart.

Roentgenologic Examination is entirely negative for any abnormality of the lumbar spine but there is a questionable haziness of the right sacro-iliac joint (unaffected side), which may betoken a pathologic process here. The left sacro-iliac joint is apparently normal.

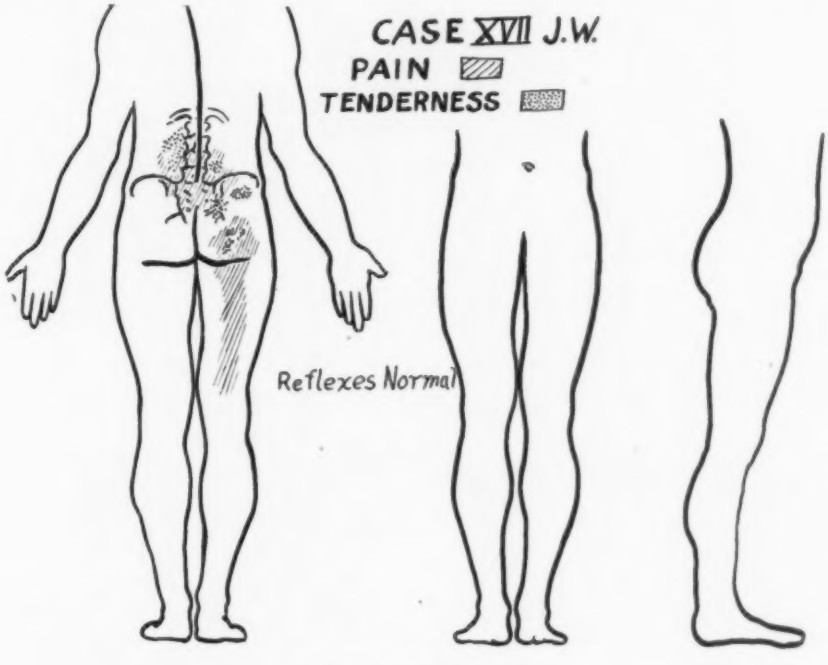


FIG. 31. CASE XVII

CASE 17. J. W. Age 24. Occupation: truck driver.

P. I.: About two years ago first began to notice pain across the lower part of the back, especially on the right side. Soon this began to work down into the back of the right hip and thigh, and it has been present more or less ever since. When he gets up in the morning he is crippled, but twenty minutes' walking straightens him out. If he works the whole day he has very little pain, but after resting it is quite sharp. Pain is also noticed when he coughs. The severity seems to be increasing.

Examination: Well developed and muscular. *List:* There is a distinct but slight list of the entire spine to the left. *Posture:* Antero-posterior curves of the spine a little increased. The upper trunk is thrown back and overhangs the pelvis.

Spinal Movements: Forward bending free and painless, but is accompanied by a little rotation to the right in the lower dorsal and upper lumbar region. Lateral bending is free in both directions, but each causes a little pain above the opposite iliac crest. Backward bending free, but causes pain across lumbo-sacral region. There is definite spasm of the muscles at the left of the lumbar spine.

Lying Straight Leg Raising: On the *right* to 60 degrees; on the *left* to 60 degrees.

For Pain, Tenderness, and Neurologic Examination: See chart.

Roentgenologic Examination: Films were lost.

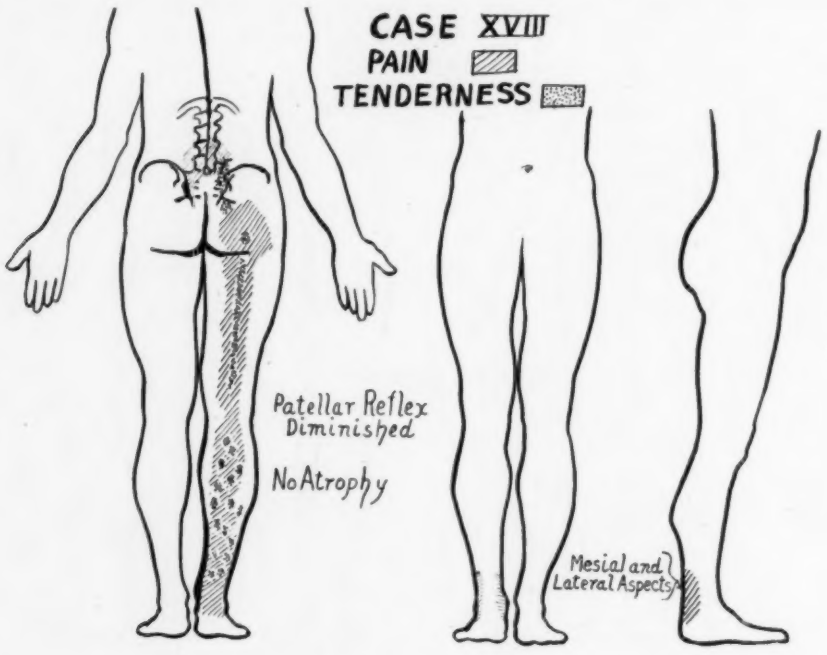


FIG. 32. CASE XVIII

CASE 18. R. W. Age 29. Occupation: carpenter.

P. I.: Two months ago, while walking on wooden platform, the end of a board tilted down, letting the left leg pass down through, and he fell heavily on the right buttock. Had severe pain in back of right hip, and at the end of two weeks this began gradually to work down the back of the thigh into the calf of the leg. The pain persisted and was very severe until three weeks ago, when a plaster jacket was applied, with much relief. Standing is most comfortable; sitting next; while lying causes the pain to start, and is least comfortable.

Examination: Slender, but good musculature. *List:* Decided list of spine to left, giving total left curve. Spasm in muscles to left of lumbar spine.

Spinal Movements: Forward bending much limited, but painless. Backward bending almost nil, but painless. Lateral bending to left is more free and occurs at a lower level. It causes a little pain in the right sciatic notch.

Lying Straight Leg Raising: On *left* to 80 degrees, without pain; on *right* to 60 degrees, where it causes pain down back of right thigh.

Roentgenologic Examination: The fifth lumbar vertebra is symmetrically placed on the sacrum. The transverse processes are large and fin-shaped, but are not in contact with the ilium and apparently do not impinge on the sacrum. The lumbo-sacral angle appears flatter than usual. The sacro-iliac joints are apparently normal.

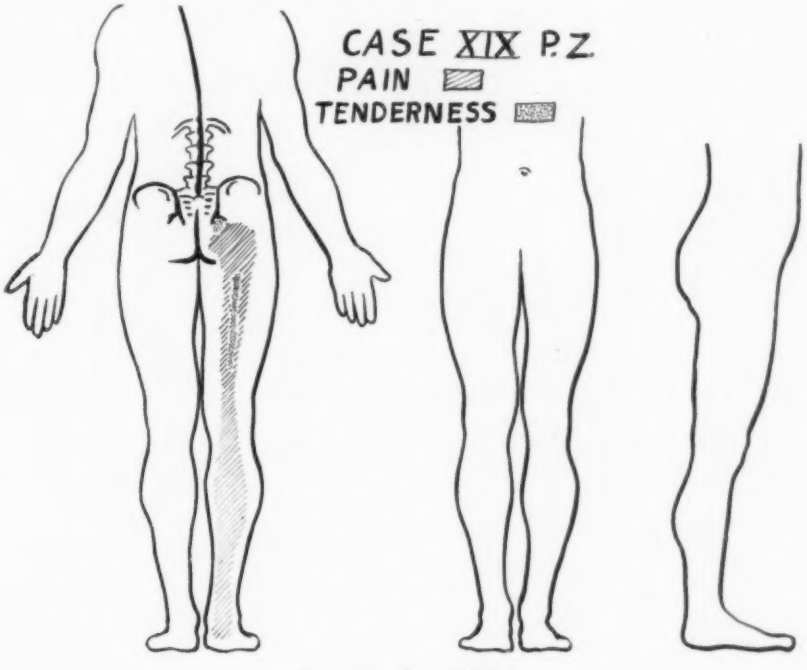


FIG. 33. CASE XIX

CASE 19. P. Z. Age 33. Occupation: fruit dealer.

P. I.: Four months ago he began to notice pain in the back of the right hip, shooting down the back of his leg. This came on gradually and was not very severe. It lasted about one month. Following this he was absolutely well until two weeks ago. He at times noticed a little stiffness in the back. Two weeks ago the pain reappeared and is now felt radiating from the right of the low back to the heel. It is increased in severity and is constant day and night. It is particularly bad when he moves or sits. Unable to walk. Relieved by recumbency with pillow under the right knee. His general health is good, but when the trouble began he had severe headache, associated with vomiting, which lasted two or three days.

P.H.: Influenza in 1918. This hung on for a considerable time and pulled him down. Went South in 1919 for three or four months, and upon his return was apparently well. An attack of rheumatism localized in the right knee ten years ago.

Examination: Small, slender man. *Posture:* Markedly bad. *List:* Spine deviates to the left in a total left curve.

Spinal Movements: Forward bending limited at about 65 degrees of flexion. Backward bending free. Lateral bending slightly limited to the right. Free to the left. Causes no pain.

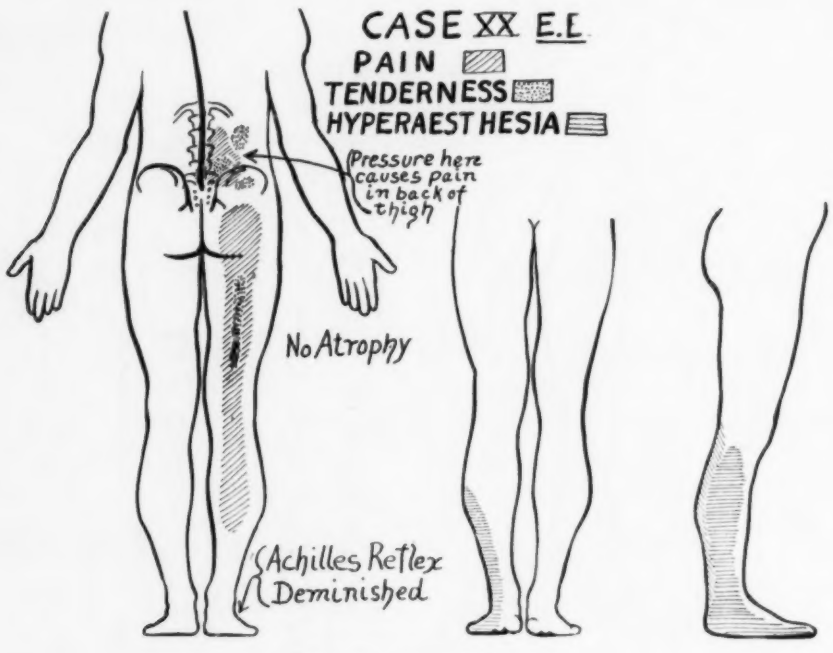


FIG. 34. CASE XX

Straight Leg Raising: On *right* to 35 degrees, where it causes pain in the back of the thigh. On *left* limited at 60 degrees.

For Pain, Tenderness, and Neurologic Examination: See chart.

Wassermann: Negative.

Roentgenologic Examination: Roentgenograms lost.

CASE 20. E. B. Age 29. Occupation: medical student.

P. I.: About two months ago patient was ill with bronchitis. Was in bed at home for a period of five days. Within one or two days after beginning to get out, while descending the subway steps, and without any particular slip, was seized suddenly by an acute pain in the right side of the back. This wore away within five minutes, but was followed by a sense of soreness and severe pain upon the slightest movement,

localized in the low back, right side. Was home in bed for nearly one week. The pain gradually lessened, but was succeeded by a spot of soreness in the right buttock. About one month ago the pain began descending into the right leg. The pain has been very intense and is increasing in severity. It is most severe when he sits or when he first stands after lying. It is relieved by recumbency, but recently movements in bed are becoming painful. Has not been able to sit for over a month. General health good.

Examination: Tall, slender, well-developed man. *Posture:* The lumbar spine is quite flat, with obliteration of the normal lumbar curve. *List:* Stands with distinct total list of the spine to the left.

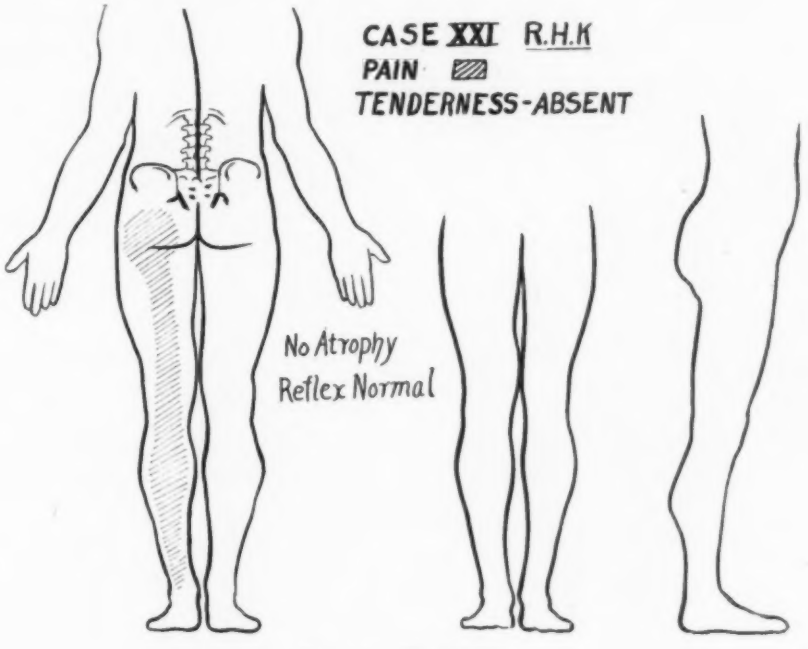


FIG. 35. CASE XXI

Spinal Movements: Backward bending is practically nil and attempted movement causes pain in the thigh. Forward bending is markedly limited at about 35 degrees of flexion and causes sharp pain in the back of the hip and thigh. Lateral bending to the right is sharply limited and causes pain as above. Lateral bending to the left is free and painless. Definite muscle spasm to the right of the lumbar spine.

Straight Leg Raising: Limited on *right* by pain and spasm at about 35 degrees. On *left* limited at 60 degrees, but no pain.

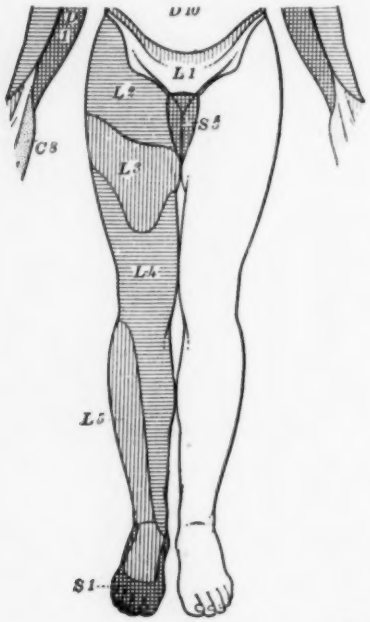
Rectal Examination: Very marked tenderness on pressure in right sacro-sciatic notch.

For Pain, Tenderness, and Neurologic Examination: See chart.

Roentgenologic Examination: Shows a medium set sacrum with apparently normal sacro-iliac joints. The body of the fifth lumbar is in symmetrical relation to the sacrum. The posterior articulations are clearly shown and apparently normal. The transverse processes of the fifth are of medium size and show no possibility of impingement on either the sacrum or ilium. On the right side there is a definite shadow, as of a band extending downward from the lower margin of the transverse process of the fifth to the sacrum. No similar structure on the opposite side.

FIGS. 36 A, B, C, D, E.

Figures showing the cutaneous distribution of the spinal nerves, according to various authors. Note that nerve supply of the outer side of the lower leg and the region of the ankle is ascribed to L V by the majority.



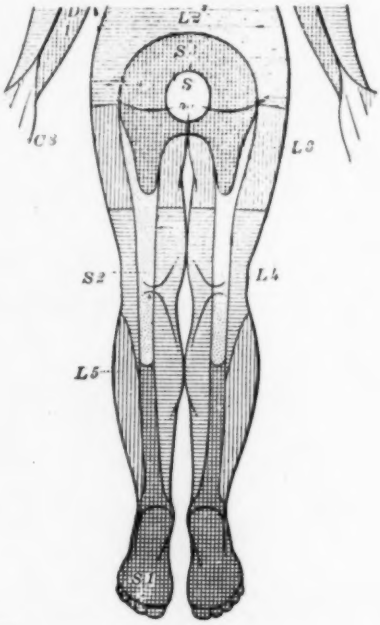


FIG. 36A

Illustrating the segmental spinal sensory areas. Front view. (After Jeliffe and White.)

Illustrating the segmental spinal sensory areas. Rear view. These or similar sensory charts are useful in plotting sensory changes. (After Jeliffe and White.)

CASE 21. R. H. K. Age 24. Occupation: employee of grain and flour concern. Does heavy lifting.

P. I.: Three months ago, while unloading sacks of grain, he slipped and wrenched the left side of the back. He was able to walk, but shortly afterwards he had a sensation

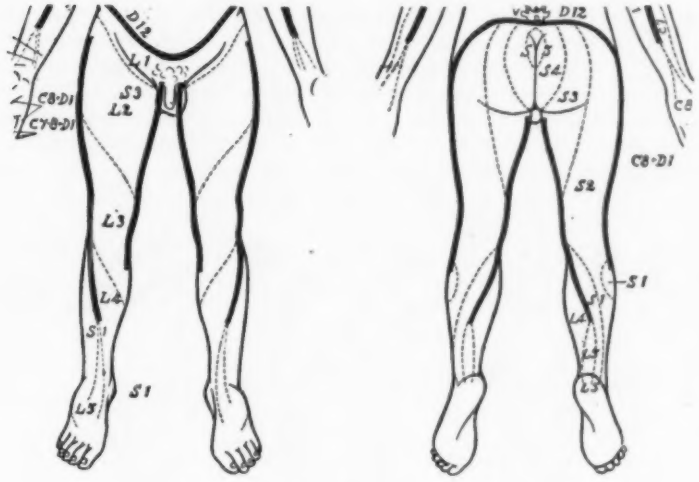


FIG. 36B

The sensory distribution of the posterior spinal roots according to Flatau.

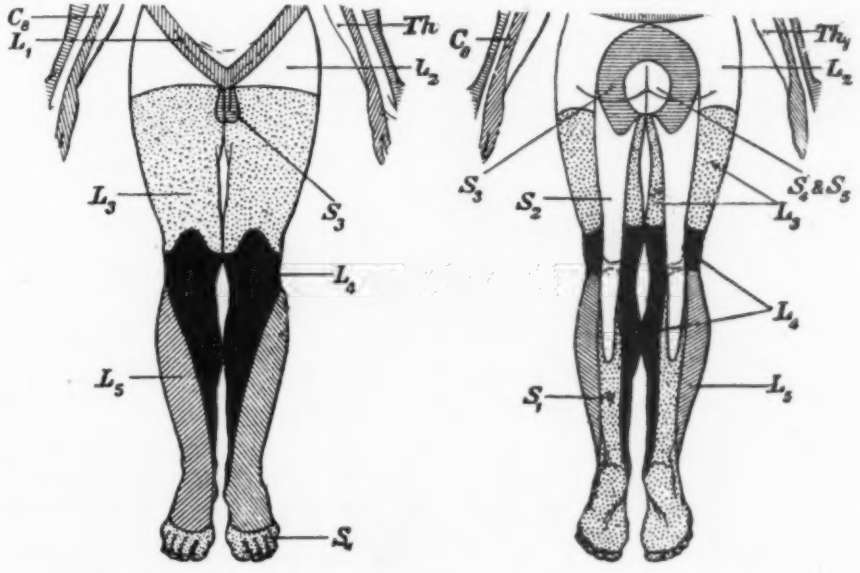


FIG. 36C

Diagram of Cutaneous Areas of Posterior Roots. (After Collier and Purves Stewart.)

of pain in the left foot; also some pain in the calf of the left leg, the posterior aspect of the left thigh and buttock. This has increased and he is now unable to sit for more than a short period because of the pain which it provokes. Lying is fairly comfortable, but standing is the most comfortable position. General health always good.

Examination: Rather stout man. *Posture:* Stands with cervico-dorsal kyphosis a little increased. The lumbar curve is about normal. The upper trunk is thrown backward somewhat in relation to the pelvis. *List:* Has a very slight left lateral deviation.

FIG. 36D

Sensory Disturbances in Relation to Spinal Disease.

Spinal Movements: Forward bending is somewhat limited and causes pain in the left popliteal space. Backward bending is fairly free, but causes very slight pain as above. Lateral bending to the right is free, but causes a little pull in the left calf. Bending to the left is very free, but causes a little pain in the left buttock and in the back of the left knee. A little spasm of the muscles at the right of the lumbar spine.

Straight Leg Raising: On *right* to 45 degrees where it causes pain up and down the posterior portion of the thigh. On *left*, it is limited at 20 degrees and causes pain in the left calf.

For Pain, Tenderness, and Neurologic Examination: See chart.

Blood Pressure: 122/84.

Rectal Examination: Slight tenderness in both sciatic notches; tenderness most marked in the mid line over the lower part of the sacrum.

Roentgenologic Examination: Shows five normal lumbar vertebrae. There is a sixth segment imperfectly formed and suggesting the top of the sacrum, but apparently is not fused to it. The sacro-iliac joints are apparently normal. The lumbar spine is symmetrically related to the sacrum. The transverse processes of the fifth lumbar are small and show no evidence of impingement. The sixth segment has a well formed neural arch and spinous process with large transverse processes, the one on the right being apparently not fused with the lateral mass of the sacrum, while the one on the left may be fused.

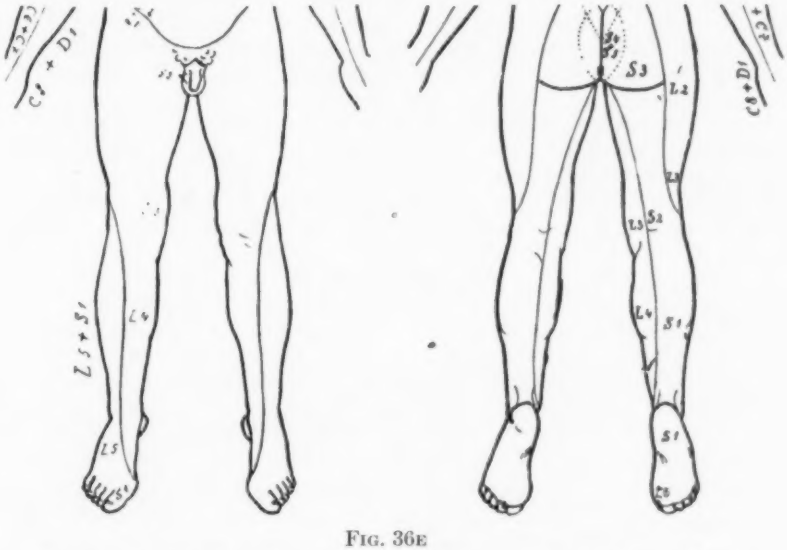


FIG. 36E

Diagram of spinal sensibility. (After Seiffer.)

Diagram of spinal sensibility. (After Seiffer.)

DISCUSSION ON PAPERS OF DRS. DANFORTH AND WILSON, WHITMAN, SMITH-PETERSEN, AND BALDWIN.*

DR. W. W. PLUMMER, Buffalo, N. Y.: This has been a very interesting group of papers which we are very much in need of. I feel that progress is being made in an attempt at least to make a differential diagnosis of these various lesions, and the further we can get away from the diagnosis of "low back pain" the better we shall be. There still seems to be some conflict in what ought to be a fairly definite classification of the

* See Journal of Bone and Joint Surgery, October, 1924, for other papers of this Symposium.

pain symptoms in relation to the pathology that should be developed in these situations. However, I think these studies, on the part of every one, particularly along the line of systematic examination, ought to be fairly helpful in the way of giving a more definite policy. There is one point that we must keep in mind, and that is, that many of the symptoms in these cases are subjective, at least so far we have not developed a systematic series of real objective symptoms on which we can always rely. The problem of the industrial back, which is becoming more serious all the time in the way of proper classification of the men who are hurt, could be more simplified, and we should work out more definite signs in the classification of these cases.

There are one or two questions I would like to ask. I note in Dr. Whitman's operative case that motion (and this ought to be stressed) at the sacro-lumbar joint did not produce pain.

I would like to ask Dr. Baldwin if by any chance in his cases it was found that pain developed on the side opposite to that in which sacralization had taken place. We have observed one case in which pain was localized in the sacro-iliac joint on the opposite side, and operative fusion of this joint gave relief.

Dr. F. J. Gaenslen, Milwaukee, Wis.: I am sure we are all very much indebted to the men who have contributed to the symposium. The cases of so-called chronic back strain are extremely numerous, and the economic importance of this whole problem is difficult to overestimate when one considers that the disability period extends into months and years. Any addition, therefore, to our knowledge of the subject is most welcome.

I was much interested in the anatomic investigations made by Drs. Danforth and Wilson. In the few skeletons I had the chance to examine recently the fifth lumbar was certainly the smallest of the lumbar foramina. Dr. Goldthwait called attention in his pioneer work on the anatomy of the lumbo-sacral region to the fact that the anatomy of the lumbo-sacral facets varied a good deal, and the variations in this region are most important in their relations to injury or strain. I would like Dr. Danforth to tell us whether or not encroachment upon the intervertebral foramina during spinal movement is more likely with certain types of the lumbo-sacral facets. Experimental studies with reference to this point of determining what type of back is most vulnerable would be instructive. It is worthy of note that none of these cases were in children or in adults younger than twenty-one years of age. It would seem that the spine in the early years is able to take up the strain more readily and to distribute it through the skeletal frame without difficulty, but in the adult, strain and injury is very apt to be localized at the lumbo-sacral junction.

As to removal of the transverse processes for impingement, I may say that my experience is limited. I have removed the process on one side in but one case and considered the operation a rather severe and difficult piece of work. I do not know, however, that I shall be persuaded to do the next one through the route Dr. Baldwin suggests. I think he should be complimented on devising this route and I am sure we will all be open to conviction that this may be an easier route than the posterior. His incision seems to me to be prolonged rather farther forward than would seem necessary at first glance. Stereoscopic roentgenograms are essential but it must be borne in mind that it is difficult if not impossible to determine whether actual impingement exists or whether there may be a space in the antero-posterior direction between bodies casting overlapping shadows. An easy way of determining whether there is an actual

space between the ilium and the tip of the transverse process is to have the patient turn partly to the side, about 45 degrees, so that the central ray of the X-ray tube will be parallel to the wing of the ilium. This position will demonstrate a space between the transverse process and the ilium if it is present. In all Dr. Baldwin's cases there was no question of impinging because the processes were so large that they articulated with the ilium. Where this articulation does not exist roentgenograms as indicated above, will settle the question of impingement. Dr. Baldwin had no paralysis following any of his cases. It is admitted that operation by the posterior route has resulted in permanent nerve injury in a number of instances. It may well be that Dr. Baldwin's route is the safer.

The type of back outlined by Dr. Whitman I am sure is a distinct type and do not doubt but that all of us have seen cases corresponding to it. Operative fixation in those that cannot be relieved by conservative means appears to be the logical remedy and certainly has worked out satisfactorily in the case reported.

Dr. Smith-Petersen deserves our thanks for summarizing and arranging in logical order the isolated facts which have been recognized by most of us as of importance in making a differential diagnosis between the lumbo-sacral and sacroiliac conditions. I agree with him that referred pain on compression of the iliac crests when present is an extremely valuable sign. It seems to me that it is practically pathognomonic.

Dr. Arthur Steindler, Iowa City, Iowa: This has been a most interesting symposium to me, especially the paper of Drs. Danforth and Wilson, for the reason primarily that I have made some anatomic investigations on the same subject and I have examined the traumatic low back in 203 cases.

As far as the anatomic investigations are concerned, I have come to the same conclusion except that I have not been able to ascertain the influence of the foramina upon the fifth lumbar nerve.

In regard to the analysis of the clinical pictures, I would like to give you the following data: Out of 203 cases, of which 187 were examined closely enough to furnish all necessary data, the anatomic variations, such as increased forward shearing stress, an impinged fifth lumbar, sacralization, spina bifida occulta or incomplete occlusion of the first sacral or fifth lumbar, occurred in 77 cases out of the 187 (35 per cent).

Secondly, in regard to symmetry, 50 per cent of the cases had symmetrical postures, showing that neither the anatomic variation nor the posture can be taken absolutely as a background for the pathologic picture. But, on the other hand, when an anomaly does occur or when asymmetry does occur it has a much greater diagnostic value. In cases of sacro-iliac sprain a contra-lateral tilt was observed in 43 per cent., and a homo-lateral tilt was observed in 15 per cent. of all cases.

Third, sciatic radiation was absent in sacro-iliac strain in 50 per cent. of the cases. But when present in all cases examined the sacro-iliac strain figured at a high percentage. The sacro-lumbar strain on the other hand figured at a high percentage in lumbar radiation, but with a low percentage of sciatic radiation.

There is one reason why I do not believe it is an impingement in the vertebral foramina rather than upon the nerve in front that causes the symptoms, and that is the signs of relief and aggravation of pain in strain located both in the sacro-iliac and sacro-lumbar group. We have found out that we can produce relief on one hand and aggravation on the other by certain positions, which forces us to the belief that movements of the spine and tension of the nerves in front of the spine have something to do with it.

Lastly, I have failed to hear any mention made of the great sympathetic nerves. We have had a considerable number of cases with irritation of the great sympathetic nerves and two cases with frequency of urination. After operation these symptoms disappeared.

Dr. H. P. H. Galloway, Winnipeg, Canada: Regarding removal of the transverse process of the fifth lumbar, we are hearing more and more about this operation, and I believe that proves that it has a place. I know that some are rather sceptical about the possible benefits of this operation. I have been doing it for at least ten years, and have been trying for a long time to get clear in my own mind the class of cases in which it is undoubtedly applicable. I never have succeeded in clearing up that point. I know that after being discouraged with other methods of treatment I have removed this process many times, and often with distinct benefit to my patients, though occasionally results have been disappointing. I have removed it sixty or seventy times—I do not mean that many patients, for I usually take it off on both sides.

The method of operation which I have adopted in all but two cases has been a straight incision, about four inches in length, with the centre of the incision a little below and just medial to the posterior superior transverse process. One can go straight down to the process, although there is sometimes a little difficulty in determining which is the fourth and which is the fifth, but after one has become familiar with the operation he usually has little difficulty in locating the process accurately. There is no serious risk to the nerve structures. I did injure some of the nerve structures in two of my early operations; in one I produced a paralysis of the tibialis anterior muscle, and in one a paralysis of the quadriceps extensor muscle. I think I have learned how to avoid the possibility of doing any damage.

After cutting down and recognizing the process, with an elevator one can strip off the muscles from almost the whole circumference. With one finger on the process, a hernia knife can also be used safely if one keeps close to the bone. Then, a point in the removal of the process which I have found of very great advantage is to keep one index finger on the process beside the chisel, holding and directing the chisel with the other hand, an assistant using the mallet; the chisel is held so that it cuts away from rather than toward the body of the vertebra. Also, throughout the operation, I have one of my assistants keep his hand upon the thigh of the side upon which I am operating, to warn me at once if any muscular twitching occurs. I have learned just how I can make the muscles twitch; this always occurs if one's instrument gets too close to the body of the vertebra. By slanting the chisel away from the body and guiding it with one finger in the depth of the wound while the assistant hammers the chisel, it can be divided with safety. Then with a sequestrum forceps it is carefully grasped and twisted gently, the assistant all the time with his hand on the thigh warning one of the slightest reflex movement. In this way the operation can be performed without any risk, and it is not very difficult if the surgeon has familiarized himself with the anatomy. I have many times removed both processes in 40 or 50 minutes.

Dr. George I. Bauman, Cleveland, Ohio: I would like to mention a few points about the etiology of some of these back cases. I think that the pain is more apt to come from some lesion of the transverse process than from pressure at the foramen. I base this on the point of tenderness to a large extent. I think the point of tenderness is much more important than the X-ray findings. If one limited the operative work on the fifth transverse process to those that showed sacralization one would not take

out very many, because those are not so common, but if you base the operative work on the point of tenderness, you will be rewarded by a great many very nice results. It seems to me that this point of tenderness indicated on the charts is exactly the point of tenderness that you can find in practically all of these cases. I think the only reason it is not charted on each one of these is that one does not go deep enough. After operating on a few of these cases you realize how deep it is and that it takes deep pressure to elicit pain.

Often the patient complains of pain down the back of the thigh on pressing in the back and one must use considerable force on the fifth transverse process down in the angle between ilium and spine to bring about that pain.

The technique of removal I think depends a good deal on where the process is and whether it is low-lying. I think the incision Dr. Galloway just described is satisfactory for an ordinary fifth. However, this low-lying fifth, such as Dr. Baldwin described, I think requires a different incision. We use a modified Bonniot incision which goes down laterally to the lumbar muscles and deviates inward toward the midline of the sacrum. We have modified the incision slightly, in that we cut off the posterior part of the superior margin of the ilium, say one-half or three-fourths of an inch, and discard it. We have dissected off the periosteum and the muscles attached to it. Bonniot cuts it off and nails it back on. We tried that in a few cases and found that it complicated the result. We got infection in one which we thought was due entirely to nailing it on. It is perfectly simple to take off the periosteum as far down as you wish to remove the bone and then expose the process. One gets a very fair exposure, and I think no damage to the nerves need be done. I have done about forty and had but one case with permanent nerve damage. I think with the improved technique I shall not have another one.

Dr. J. Torrance Rugh, Philadelphia, Pa.: I just want to say one word regarding the removal of the lateral process. I want to endorse what Dr. Galloway and Dr. Bauman have said regarding the posterior incision. I am accustomed to going in directly through the posterior part over the crest of the ilium, deepening the incision directly forward. I find it is very important before beginning the operation to determine whether I am dealing with a male or female type of pelvis. That is shown by the roentgenogram. The same thought has been presented by others with regard to the deep-seated or superficial sacrum. There is a real difference in the height of the crest, and if you are dealing with a female type of pelvis with a low crest it is very simple. If you are dealing with a male type of pelvis with a high crest it is much more difficult. In removing the process one must keep in mind that it is not necessary to remove the entire lateral process. You merely want to remove sufficient of this to relieve the pressure.

Dr. Philip D. Wilson, Boston, Mass. (closing his part of the discussion): I will answer the questions asked Dr. Danforth and myself. Dr. Smith-Petersen has brought up the point of referred pain. That is an important point and one on which we must get more light. I do not think that much is known about referred pain,—that is, about its exact mechanism. It is, according to my understanding, a projected pain, having to do with the central nervous system rather than the peripheral nerves, aside from the nerve originally irritated. It is an error in localization on the part of the cortex. It is certainly not my idea that we would find tenderness along the nerve trunk or changes in sensibility or reflex changes with a referred pain. These signs are the evidence of an actual lesion of the nerve. I should like to ask Dr. Smith-Petersen what the neurologic findings were in his cases.

Dr. Gaenslen spoke about the abnormalities which may occur in the articular facets of the fifth lumbar vertebra and asked what effect that might have upon the production of sciatic pain. Dr. Goldthwait has laid great stress on this, and we think rightly so, because the presence of such an abnormality creates a condition of instability and a potentiality of strain, which becomes still greater when there is faulty use of the body. As far as it relates to the production of sciatic pain, we can only point to the close relation of the fourth and fifth lumbar nerve roots to the posterior spinal articulations and to the great possibility of irritation at these points. Dr. Gaenslen asked why sciatic scoliosis does not occur in children. The only important difference that I can see between the skeletons of children and those of adults is that in the former the epiphyses have not yet united and they have not ceased to grow. In adult life the reverse is true. As one grows older, the intervertebral discs settle down and the spine grows shorter. That comes also from faulty posture as well as from the flattening of the discs. The intervertebral canals become smaller and there would appear to be more chance for irritation of the nerve roots.

Dr. Steindler spoke about the radiation of pain in the cases of lumbo-sacral and sacro-iliac strain which he has studied. He apparently feels that he can distinguish between these two conditions with great certainty. The trouble is that very few of us agree about the methods of differentiation, and what Dr. Steindler might call sacro-iliac we might call lumbo-sacral, or vice versa. Unless we agree with him on diagnosis we cannot agree as to the value of his figures. Our study has convinced us that sciatic pain is usually due to a lesion in the lumbo-sacral region.

Dr. Bauman spoke about the location of the tenderness, making the point that the tenderness which we have recorded in our charts, in the lumbo-sacral angle, is due to a tender transverse process. We do not agree on that point. In the first place, it is hard for me to understand how the transverse process, which is simply a bony process, should be tender unless there was an actual periostitis. On the other hand, I can readily visualize an irritation or inflammation in a strained articulation which would render it tender. The pressure which one makes here is directly over the posterior articulation, and the tender point which one finds here corresponds to its location. I assure you that when we did not find tenderness it was not for lack of making sufficient pressure to discover it.

Dr. M. N. Smith-Petersen, Boston, Mass. (closing his part of the discussion): I want to refer to Dr. Steindler's remarks about the radiation of the pain. I think that Dr. Steindler said that his sacro-iliac cases showed a small per cent. of sciatic radiation. I disagree with him; the majority of my cases showed sciatic pain. These cases were, without exception, relieved by operation.

Dr. Steindler: Fifty per cent. did not show.

Dr. M. N. Smith-Petersen: Seventy or eighty per cent. or even more of my cases showed sciatic pain.

In regard to Dr. Wilson's question about the neurologic examination: I have not performed any examination which I can call neurologic. Pain is a subjective symptom and its distribution, therefore, cannot be anatomically accurate. As far as the interpretation of reflexes is concerned: Reflexes vary on the two sides even in the normal individual. When a patient is in great pain, accompanied by muscle spasm, the absence of a reflex becomes of doubtful value.

THE METABOLISM IN ARTHRITIS

I. The Influence of the High Frequency Current on Certain Phases of General Metabolism

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(Contributions from the Evans Memorial, Boston, No. 69. A. 31.)

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I. INTRODUCTION

For a number of years it has been a more or less well recognized practice on the part of the medical profession to assume for electric currents of high potential and frequency, a helpful influence upon the level of body metabolism; particularly as a stimulant to the excretion of body wastes by the kidneys in those cases where faulty metabolism or faulty elimination is seemingly a dominant feature of the symptom-complex.

This application is the outgrowth of a series of experimental studies by Ward (Quoted by Harris, "Electrical Treatments," 1920), who showed that with rapidly alternating electrical stimuli muscular excitation increases until the speed of the alternations reaches about 3000 per second;

as the speed is still further increased the amount of muscular contraction progressively diminishes. D'Arsonval (*Ibid*) repeated and extended these experiments, and his findings and interpretation constitute in large measure the basis of present day therapeutic application.

In spite of the wide-spread use of the method and the diversity of mechanical devices which have been designed to produce these currents, there is a surprising paucity of published data of studies which are not intrinsically clinical in character. Denoyés ("Les Courants de Haute Frequence," 1902) began the use of electrical currents of divers kinds for treatment of disease in 1889 at the Hospitaux de Montpellier. His results were judged by changes in the clinical picture alone. With Matre and Rouvière (*Ibid*) he carried out a brief study of the influence of the "auto-conduction current," using three normal young men as subjects. These latter were brought into nitrogen equilibrium and then subjected to the treatment for a period of five days. Analyses were made in the pre-, current, and post-treatment periods. The significant results are collected in Table I.

TABLE I

Denoyés' Results with Three Normals. (averages) 5 Treatments of 14′ average duration. Current strength not recorded.

Observation		*Period*		
		1	*2*	*3*
Urine Volume	cc.	1400	1470	1380
Total Nitrogen	gms.	16.96	18.12	17.56
Urea Nitrogen	gms.	15.58	17.13	16.68
Uric Acid Nitrogen	gms.	0.34	0.41	0.38
Total Sulphur	gms.	1.45	1.76	1.58
N/S Ratio		11.7	10.3	11.1
Sodium Chloride	gms.	12.15	13.59	13.67
Phosphate (P_2O_5)	gms.	3.07	3.41	3.20

The results show that there is a tendency toward an increased general elimination, which subsides in whole or in part with the cessation of the electrical stimulus. The absolute magnitude of the figures must be taken with some measure of reserve (the implied low values for Ammonia, Creatinin and Residual Nitrogen are dubious) but the relationships are significant. The volumes of urine as observed would seem to eliminate diuresis as the determining factor.

So far as the present writers can learn, this somewhat meager report constitutes the extent of the literature. Denoyés reports no similar study of abnormal subjects.

Some years ago the senior author had occasion to make an analysis of some 200 cases,* falling in the category of deficient elimination, in which so-called high frequency saturation treatments were used. Rough urine studies coupled with the general clinical picture showed definite betterment in approximately 85 per cent. of the cases. This betterment varied from mild amelioration to an apparent cure, the latter being effected in a surprisingly large number of cases studied. The residual 15 per cent. showed in a few instances no change, and in a definite number—10 per cent. or more—an apparent detriment to the patient. This case analysis was supplemented by the senior author with a brief intensive study of the influence of high frequency saturation treatments on the nitrogen elimination of normal healthy young men.† With the subjects studied, in all but one there was a marked increase in the nitrogen elimination, which promptly returned to the original equilibrium with cessation of the treatments. In the one exceptional case there was apparently an impairment of the eliminative function, which equally disappeared with the cessation of the stimulation. With the exception of these highly fragmentary records, no studies seem to have been made which are wholly objective in character. The subjective character of clinical evidence circumscribes the conclusions which may be drawn from observation.

The wide-spread use of this general method of treatment—modified in protean manner by the great diversity of the mechanical appliances—was felt to warrant a study of the actual metabolic changes induced by "high frequency" electricity.

II. PLAN OF RESEARCH

To secure strictly comparable results, it was felt that the study should comprise two groups of subjects; the first of individuals suffering from some well defined, well characterized pathological condition for which this method of treatment has been extensively used; and the other a group of normal controls. For several reasons a selected series of arthritics was chosen for the first group, while several nurses and medical students volunteered to form the second.‡

The general plan of the investigation comprised blood and urine studies before, during, and after the exhibition of the high frequency

* For access to this material, grateful acknowledgment is made to Dr. John P. Sutherland.

† Unpublished data.

‡ To all of those who coöperated in this study, the authors take great pleasure in extending their appreciative thanks. Especial obligation is expressed to Dr. Alonzo G. Howard, from whose service the first group was obtained.

current. Basal metabolism determinations were included as a routine procedure, and in a few selected cases certain supplementary observations were made.

A. Diet

The selection of a diet for any metabolism study is obviously a matter of vital importance. Rigid control of the food intake is essential if results are to be more than roughly comparable. This implies an intrinsic simplicity in the diet and connotes a uniformity of substance if the laboratory analyses are not to assume a hampering multiplicity. From this standpoint the starch, cream, egg regimen of Folin offers every advantage. One extraneous factor, however, must be recognized; namely, the element of palatability. Where the duration of a test is measured in weeks, it is of primary importance that monotony of the diet shall not prove a complicating factor. From the standpoints of digestive disturbance and the equally potent element of coöperation, a certain variety is imperative. The average hospital patient lacks the urge of the scientific investigator. Willing acceptance of certain of the discomforts incident to the study may be secured, but every effort is necessary to lessen the patient's burden.

Another point requiring discussion is the unit to be adopted as the standard. The nutritional requirement based upon body weight is generally accepted, but under the ordinary conditions of practice this can be at best but a first approximation.

Recognizing that all parts of the body concert in the general metabolic complex, there must still exist wide divergences in the actively functioning tissue of, for example, the very fat and the very lean. "Normal"—which after all is average—applies to but a limited number of hospital cases. In the present study the calculated Basal Metabolic requirement (Harris-Benedict standard, based in part on body weight) ranged from 19 to 32 calories per kilogram of body weight, with an average of 24.

The additional energy requirement conditioned by voluntary activity was likewise variable. The patients in the pathological group were technically non-ambulatory, the condition varying from strict confinement in bed to the limited use of a wheeled chair. In no case was there unrestricted activity. The normals, as before stated, were students and nurses. The individual assimilation factor introduced yet another element of variation.

As the subjects were maintained on a uniform diet throughout the test and as relative results only were desired, certain of these objections lose much of their force. Recognizing, then, the limitations of the standard,

it was found most practicable for these preliminary studies to base the protein and calorie intake on the body weight. On this basis, 1.5 gms. of protein and 35 calories per kilogram of body weight were given. In the three cases showing the higher basal requirement, additional nourishment was allowed in the form of fruit and other low protein foods. Record was kept of all accessory food items. That the diet approximated maintenance is testified by the non-significant variations observed in the body weight of the several subjects during the test.

To meet the several criteria established above, the following plan was adopted. A basic ration containing approximately 60 grams of protein and yielding an average of 1650 calories of energy was first outlined.

Variety was secured by having three standard menus used in sequence, and uniformity by limiting these basic rations to materials of fairly uniform composition, as butter, cheese, certain standard cereals, eggs, and so forth. Fruits, with a low protein content, formed a palatable and permissible adjunct. The additional food was obtained by the use of the correct amounts of skim and whole milk. With approximately the same protein content, the butter fat in the latter nearly doubles the energy content of that of the former. This gives a necessary elasticity to the diet without introducing any real intricacy. For patients in excess of 80 kilos in weight, a modification should be introduced, increasing the amount of solid food. Up to that point, however, the fluid intake is not excessive.

No attempt was made to analyze the diet for its protein content, but the values given by Locke ("Food Values," Appleton, 1911) were accepted. That this would introduce minor variations was recognized, but it was felt that by rigid control of the amounts taken this error could be kept within reasonable bounds.

B. Schedule

As was stated earlier, the study comprised blood and urine analyses, the determination of the basal metabolic rate, and the Phenol-Sulphone-Phthalein test. The essential points of the daily schedule are given in Table II. Meals were served at 7:30 A. M. and 12:30 and 5:30 P. M. unless otherwise indicated.

TABLE II

Daily Schedule

First Day	
7:00 A.M.	Start collection of first 24-hour urine.
7:30 A.M.	Breakfast. Standard diet begins.

TABLE II — Daily Schedule (Continued)

Second Day	
7:00 A.M.	Complete first 24-hour urine.
	Draw 15 cc. blood.
2:00 P.M.	Start the Phenol-Sulphone-Phthalein test.
Third Day	
8:00 A.M.	Basal Metabolism.
9:00 A.M.	Breakfast.
11:00 A.M.	High Frequency.
Fourth to Ninth Day (inclusive)	
11:00 A.M.	High Frequency.
Tenth Day	
7:00 A.M.	Start collection of second 24-hour urine.
	Draw 15 cc. blood.
8:00 A.M.	Basal Metabolism.
9:00 A.M.	Breakfast.
11:00 A.M.	High Frequency (last treatment).
Eleventh Day	
7:00 A.M.	Complete second 24-hour urine.
2:00 P.M.	Start second Phenol-Sulphone-Phthalein test.
Thirteenth Day	
7:00 A.M.	Start collection of third 24-hour urine.
8:00 A.M.	Basal Metabolism.
9:00 A.M.	Breakfast.
Fourteenth Day	
7:00 A.M.	Complete third 24-hour urine.
	Draw 15 cc. blood.

TEST ENDS

C. Methods

All urines were subjected routinely to a thorough chemical and microscopical examination. Quantitative measurements were made by standard methods of proven accuracy, in the main, procedures suggested by Folin and his co-workers.

Primarily all blood analyses were conducted in accordance with the Folin-Wu (J. Biol. Chem., 38–1, 1919) procedure. With the last few cases, the Benedict-Franke (J. Biol. Chem., 51–1, 1922) method for uric acid was substituted. For the Phenol-Sulphone-Phthalein test comparisons were made with the Dubosecq colorimeter.

Basal metabolism determinations were made with the Benedict-Collins (Boston M. and S. Jour., 183–449, 1920) portable apparatus. The relative merits of the open and closed circuit types of apparatus have been thoroughly and heatedly discussed in the literature. For the

immediate purpose, this instrument was most excellently adapted. Comparisons were made, following the practice of this laboratory, with both the Harris-Benedict (Carn. Inst. Pub., 279, 1919) and Aub-duBois (Arch. Int. Med., 17–863, 1916; Arch. Int. Med., 19–823, 1917) standards. The occasional bizarre results shown by the latter do not exercise any influence in this study, as all results are comparative, and constant errors cancel out. Only when the absolute magnitude of the basal metabolic rate is significant, does this question arise.

Electrical Treatment

The apparatus used was a Campbell "Model I" high frequency coil in connection with a Campbell "Treatment Chair." One pole of the machine is connected through a hot wire milliammeter with the insulated plates which form the seat and back of the chair. The other goes direct to two metal balls fastened to the arms of the chair, and on which the patient's hands rest. It was found helpful in certain cases to interpose pads of gauze moistened with salt solution between the hands and electrodes. The intention was to give a dosage of 1000 milliamperes for fifteen minutes on each of eight consecutive days. This was found to be impracticable in certain cases, but was adhered to as closely as the circumstances would permit. With certain patients there were marked fluctuations in the current strength, necessitating constant regulation of the mechanism—others showed a great constancy in the amount of current used.

D. Subjects

The significant data concerning the subjects of the tests can be presented most concisely in tabular form.

TABLE III

Subjects

Group	*Case No.*	*Sex*	*Age*	*Height*	*Diagnosis*
Control	1N	F	19	167	Normal
	3N	F	35	162	Normal
	4N	M	26	167.5	Normal
	5N	M	22	169.5	Normal
Chronic	1	F	26	151	Chronic Infectious Arthritis
	2	M	45	167	Chronic Infectious Arthritis (poly)
	5	M	65	160	Chronic Infectious Arthritis
	6	F	45	175	Chronic Infectious Arthritis
	7	F	39	169	Chronic Infectious Arthritis
	8	M	27	161	Chronic Infectious Arthritis (poly)
	9	M	39	162	Chronic Infectious Arthritis (poly)

TABLE III — Subjects (Continued)

Group	*Case No.*	*Sex*	*Age*	*Height*	*Diagnosis*
	11	M	24	168	Chronic Infectious Arthritis
	13	F	34	160	Chronic Infectious Arthritis
Chronic-acute	14	F	45	151[5]	Acute Exacerbation of Chronic Infectious Arthritis
Acute	10	F	53	163	Acute Polyarthritis
	12	F	54	158	Acute Hypertrophic Arthritis

III. RESULTS

The results of the study fall naturally into three groups. First, the gaseous metabolism; second, the indices of kidney function shown in the urine picture, the blood analysis, and the phthalein test; and third, the nitrogen and sulphur partitions. These can be discussed seriatim. In the interest of brevity no attempt will be made to present the individual data of these studies. Relative values were desired, and averages present these relationships concretely. It may be said, however, that the individual members of each group conform to the picture presented by the average.

A. Basal Metabolism

The pertinent data of the several tests can be presented most compactly in tabular form, and are collected in Table IV. Complete records were obtained on fifteen subjects.

TABLE IV

Observation	Basal Metabolism *Period*	*Control*	*Group* *Chronic*	*Chronic-Acute*	*Acute*
Body Weight.....(kilo)	1	63.2	50.0	43.9	54.6
	2	63.2	50.5	43.9	54.4
	3	62.9	50.2	43.7	54.1
Temperature.....(deg.)	1	97.6	98.0	97.4	98.1
	2	97.3	98.0	97.2	98.2
	3	96.6	98.2	97.8	98.1
Pulse.....(r.p.m.)	1	64	78	68	77
	2	59	76	61	71
	3	62	78	64	72
Respiration.....(r.p.m.)	1	14	15	16	13
	2	14	14	13	12
	3	14	16	14	13
Basal Metabolism.....	1	—3	—5	+11*	—11
Deviation in per cent.	2	—9	—9	—2	—23
	3	—3	—10	—1	—28

* Value doubtful. Patient slightly nervous.

Only the curve of the normals shows any upward trend, and this is of too small a magnitude to be significant. The general tendency of the arthritic cases is downward, and is apparently persistent after the cessation of the electrical stimulation. While the drop observed is not of striking proportions, it is too large to be ignored.

Several of the cases showed a basal metabolic rate highly suggestive of endocrine disturbance, with the thyroid as the probable focus. While this aspect of the matter is not germane to the present discussion, it may be said in passing that a very definite percentage of arthritic cases simulate in marked degree, a state of hypo-thyroidism. This has been commented on frequently in the literature.*

Inspection shows that there were changes of body temperature in certain of the cases in the series. While temperatures were taken orally and were consequently not wholly reliable, no serious error should exist in comparative values. If all the B. M. rates be calculated to a constant temperature by use of the coefficient suggested by duBois† no intrinsic change is produced in the general relationship, although the tendency of return of the normal group to a value above the pre-treatment level is somewhat more marked. The respiration rates throughout show an excellent level of uniformity, and changes in the pulse rate have been shown by Benedict to be without influence on the basal metabolic rate.

Another use of the high frequency treatment has been to lower blood pressure. None of the cases studied showed hypertension, so that a real index of this influence is lacking. In the main, there seems to be little definite effect; a few cases showed a fall of several mms.; and equally others showed an increase. Three typical cases are:

No. 8	80/44,	98/48,	120/52
9	136/70,	124/102,	120/96
14	125/80,	120/72,	124/80

It is certainly warranted to conclude that no striking influence is manifested. To summarize, beyond a slight but unmistakable fall in the basal metabolic rate, no special influence is observed.

B. Kidney Function

Of the 16 recorded cases, three showed albuminuria, and all but three of the arthritics showed urate or oxalate crystals in the sediments. Other

* Among others recently Swaim (Jour. Bone and Joint Surg., 4-426, 1922) has discussed the topic at length.

† Thirteen per cent. for each degree of temperature Centigrade or 7.2 per cent per degree Fahrenheit.

abnormal elements were absent. Noteworthy is the failure to find casts in any of the urines examined. Certain other data are given in the following table:

TABLE V

Urine Analysis

Observation	*Period*	*Group*			
		Control	*Chronic*	*Chronic-Acute*	*Acute*
Volume.....(cc.)	1	1270	1050	1000	560
	2	1710	1270	2060	970
	3	1340	1030	1800	930
Specific Gravity.....	1	1.021	1.019	1.018	1.025
	2	.020	.019	.014	.019
	3	.019	.018	.012	.025
Sodium Chloride.....(gms.)	1	10.99	5.17	6.47	4.22
	2	12.21	7.70	6.63	5.48
	3	10.40	6.56	7.47	5.61
Phosphoric Anhydride.(gms.)	1	2.38	1.35	1.18	1.14
	2	2.40	1.71	1.49	1.12
	3	2.17	1.25	2.04	1.37

The same general tendencies are shown by all. There is an increased water elimination during the second period, with recession during the third in the normal and chronic groups. The acute cases show a permanent increase. The unchanging specific gravities imply an increase in solid elimination in the normal and chronic groups, duplicating the observations of the volume changes. The drop in specific gravity with the acute cases is more than compensated by the larger volume increase and the curve of elimination is definitely and progressively upward. Both salt and phosphate elimination repeat the foregoing relationships.

No attempt was made to control the salt intake in any of the tests. The definitely lower level of the arthritic group was possibly conditioned by selection. This is not the case, however, with the phosphoric acid elimination. These points will be taken up in the general discussion.

The Phthalein test was applied both in the pre- and post-treatment periods. The individual observations illustrate the somewhat doubtful authority of this test, but the averages, as shown in Table VI, fail to show any real differences of performance. There may be some import in the observation that the acute cases show a lower level of elimination than the controls or chronics, but the number of cases studied is far too few to warrant any generalization.

TABLE VI
Phenol Sulphone Phthalein

Group	No.	Before Treatment 1st Hour	2nd Hour	Total	After Treatment 1st Hour	2nd Hour	Total
Normal	4	44	24	68	45	23	68
Chronic	9	45	20	65	42	24	66
Chronic in Acute Phase	1	33	18	51	35	20	55
Acute	2	31	19	50	26	21	47

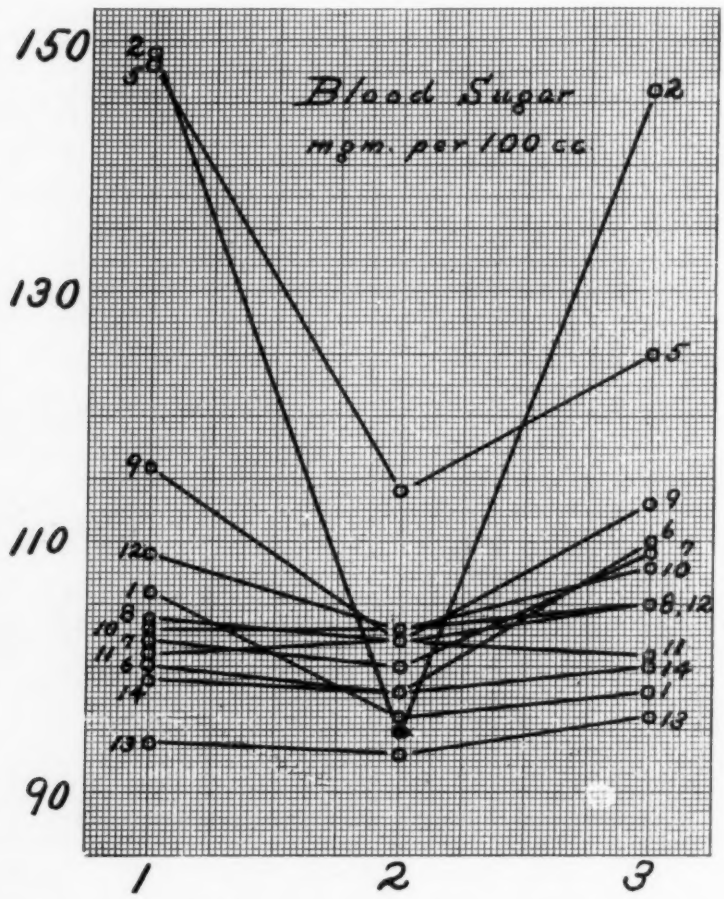
The blood analyses given in Table VII indicate some interesting relationships.

TABLE VII
Blood Chemistry

Constituent	Period	Normal 4	Chronic 9	Chronic With Acute 1	Acute 2
Non-Protein N_2	1	36	35	31	40
	2	34	31	29	38
	3	34	34	30	34
Urea N_2	1	13	14	16	19
	2	12	12	11	16
	3	14	13	12	14
Uric Acid	1	3.2	3.4	2.1	2.6
	2	2.9	3.0	2.1	2.6
	3	3.0	3.2	2.5	2.8
Creatinin	1	1.4	1.4	1.5	1.5
	2	1.5	1.4	1.4	1.5
	3	1.5	1.4	1.5	1.5
Residual N_2	1	21	19	14	20
	2	22	17.5	17	21
	3	18	19	17	18
Sugar	1	86	113	99	106
	2	80	100	98	103
	3	87	111	100	107

First, the blood sugar averages show a practically uniform fall with recovery. The degree of the change in the individual cases is almost

directly proportional to the initial level. Only three of the cases showed blood sugars above the upper limit of normalcy (2, 5, and 9), and in these the fall was marked. Case No. 2, with an initial level of 149 mgms., drops to 95 and recovers to 146. The others are less striking. Graphic repre-

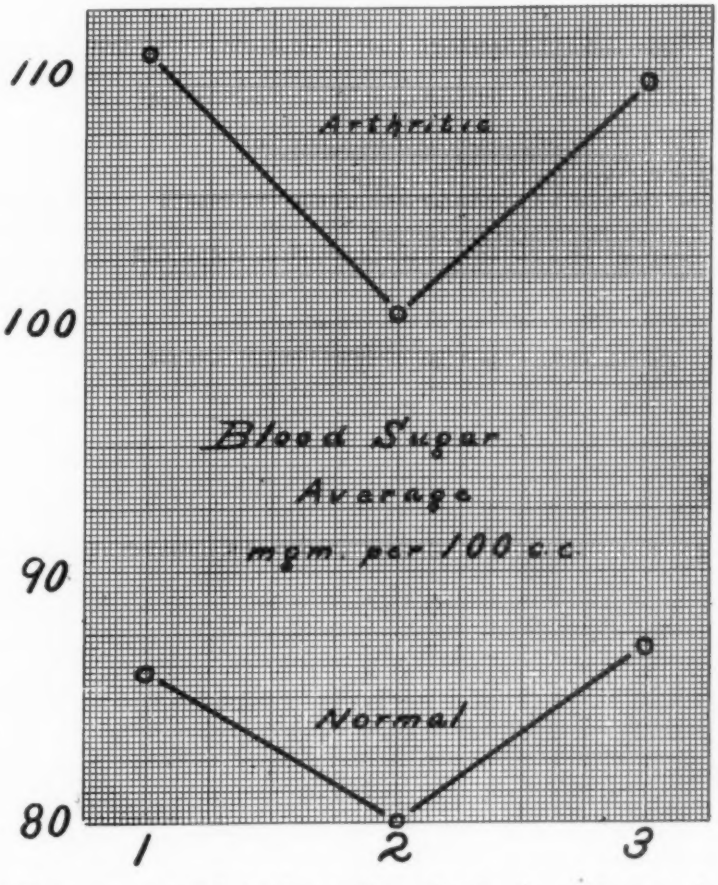


sentation of the individual observations is given in Curve I, and the average curves of the normal and arthritic groups in Curve II.

The nitrogen fractions of the blood are also informative. All creatinin values fall well within so-called normal limits; the uric acid of the chronic cases approximates that of the controls; while that of the acute group is found at the characteristic lower level of arthritis. Non protein

and urea nitrogen values do not depart from the normal, and only in the acute group do they manifest any tendency so to do.

The influence of the electrical treatment is, on the whole, well marked. The creatinin content, with but minor exceptions, remains unchanged. The variations in the non protein and urea nitrogen and the uric acid



show the same general tendency throughout—the differences being of degree rather than of kind. The electrical treatments apparently cause a slight diminution in the several substances, while cessation induces a tendency to return to the former level. The exception to this general rule is shown by the acute cases, where the downward tendency seems to persist and even to intensify.

The authors are acutely conscious of the lack of warrant for any generalization where so few cases are available for comparison. At best apparent tendencies are indicated, and these are subject to the revision that a larger group of cases might necessitate. To summarize, the nitrogenous elements of the blood seem to betray a slight downward tendency under the stimulus of the electrical treatment, with a similar, though even less well marked, upward change when the exciting factor has been removed. Blood sugar, however, does show a definite decrement which is apparently dependent upon the electrical influence and abruptly returns with the cessation of the stimulus.

C. Nitrogen and Sulphur Partitions

Representing, in largest measure, the end stadium of protein metabolism, the results of these analyses present special points of interest. The data for the nitrogen analyses are given in Table VIII.

TABLE VIII

Nitrogen Partition

	Period	*Control* 4	*Chronic* 9	*Chronic In Acute* 1	*Acute* 2
	1	11.59	8.32	8.51	5.32
Total N_2	2	13.56	10.66	9.90	7.77
	3	11.42	8.33	9.57	8.58
	1	9.91	7.09	7.67	4.53
Urea N_2	2	11.79	9.17	8.62	6.80
	3	9.88	7.29	8.11	7.59
	1	0.17	0.13	0.09	0.07
Uric Acid N_2	2	0.17[5]	.16	.09	.11
	3	0.13	.13	.10	.12
	1	0.50	0.42	0.40	0.23
$N H_3 N_2$	2	.61	.58	.74	.45
	3	.53	.44	.42	.41
	1	0.48	0.34	0.30	0.22
Creatinin N_2	2	.51	.37	.32	.30
	3	.46	.27	.30	.28
	1	0.53	0.34	0.05	0.27
Residual N_2	2	.47	.38	.13	.11
	3	.42	.20	.64	.18

The total nitrogen shows a wholly characteristic relationship with increase in the treatment period, while in the post treatment phase the

controls and chronics return to the earlier level, the acute cases show progressive increase, and the chronic-acute case occupies the middle ground, nearly maintaining the advantage gained. As could well be predicted, the urea shows similar relationships, as does uric acid. Ammonia and creatinin show the characteristic curve of elimination in the groups of controls and chronic cases; the chronic-acute curves also take this form, while the acute cases show an increase which is not wholly maintained in the third period. The curves for the residual nitrogen are in some measure anomalous, but as this moiety is determined by difference and so absorbs all the analytical errors of the several other determinations, too great weight need not be given to slight differences which, while relatively large, are of minor absolute magnitude. A point of possible interest in this connection is the relative normalcy of the amount of the residual nitrogen fraction. As the senior author has recently pointed out (Rowe, Boston Med. and Surg. Jour., 191–151, 1924), a notable increase in this partition is observed in a large number of endocrine cases. In no single observation in this series did the residual nitrogen exceed normal limits, which is perhaps significant, when the low basal metabolic rate of some of the cases is considered.

The details of the sulphur analyses are given in the next table. Avoiding the usual convention, sulphur is expressed as such and not as the anhydride. The varied character of the so-called "neutral" sulphur fraction makes this desirable.

TABLE IX

Sulphur Partition

	Period	*Normal*	*Chronic*	*Chronic In Acute Phase*	*Acute*
Total S	1	0.973	0.695	0.774	0.463
	2	1.067	.854	.830	.656
	3	.904	.652	.847	.718
Inorganic S	1	0.749	0.503	0.586	0.357
	2	.808	.628	.584	.494
	3	.681	.466	.616	.532
Conjugate S	1	0.038	0.046	0.028	0.023
	2	.079	.053	.041	.018
	3	.040	.038	.038	.035
Neutral S	1	0.186	0.146	0.160	0.083
	2	.180	.173	.205	.144
	3	.183	.148	.193	.151

The relationships here shown but repeat those observed with the nitrogen fractions. The neutral sulphur fraction shows a minor variation in the normal group, but as the quantity is obtained by difference and the amounts involved are but a few milligrams, it is without significance. In view of the urine nitrogen and sulphur, a study of their relationship has possible significance. The ratios are collated in the next table.

TABLE X
N/S Ratio

		Periods		
Group	*No.*	*1*	*2*	*3*
Control	4	11.9	12.7	12.6
Chronic	9	12.0	12.4	12.7
Chronic-Acute	1	11.0	11.9	11.3
Acute	2	11.5	11.8	11.9
Average		11.9	12.4	12.5

The differences which occur are of a magnitude to connote significance. What this may be, however, cannot at this time be stated with any certainty.

IV. DISCUSSION

It should be said, initially, that the present series of cases is too limited in number to warrant any sweeping generalization. On the other hand, definite tendencies are exhibited. That the so-called high frequency current does exercise some influence on the level of body metabolism is patent. Equally, under the conditions of experiment, the effect is evanescent in all but those cases in which there exists an active acute morbidity. While these studies were not exact metabolism measurements, the relation of nitrogen intake to output possesses a certain interest. An approximate statement is given in the next table.

TABLE XI

Relation of Nitrogen Intake to Output in Urine

		Group			
	Period	*Control*	*Chronic*	*Chronic-Acute*	*Acute*
Average Weight.....(kilo)		63	50	44	54
Nitrogen Intake (approximate).....gms.		15.5	12.5	11	13.5
Nitrogen in Urine...(%)	1	75	66	77	36
	2	88	85	90	52
	3	74	66	87	57

While the normal level of the chronic group is somewhat low, the figures of the first three groups do not compare unfavorably with those obtained by Goldthwait, Painter, and Osgood (Am. Med., VII–547 and 590, 1904) in a case of hypertrophic arthritis.* The acute group constitutes a striking exception. Here initially only one-third of the ingested protein is apparently metabolized, and in the post-treatment period the percentage is still lower than any recorded for the other groups. Three possibilities suggest themselves; namely, changes in (A) absorption, (B) oxidation, and (C) elimination of food materials or their wastes.

In regard to the first, analyses of the faeces would be most illuminating, and these regrettably are not available. That this may play some part is evidenced by one of the arthritic cases already cited, in which fecal nitrogen was 15 per cent. of the wholly inadequate intake. This could hardly account, however, for the disappearance of two-thirds of the total nitrogen observed in the first period.

The change in the basal metabolic rate might be adduced to explain in part the second possibility; but the chronic group offers data which are wholly at variance with this concept, for while the lowered rate persists, the nitrogen ratio goes back exactly to the pre-treatment level. Further, this group, comprising over half of the cases studied, has a definite authority.

Canvassing the third possibility, the Phthalein test gives no indication of an improved kidney permeability. As before stated, however, the test is not highly dependable and its findings may well be ignored. In the blood chemistry, however, is found a more dependable index, and here the evidence would seem to be for a distinct improvement in kidney efficiency. True, the changes are scarcely of the magnitude of those observed in the urine, but it is to be remembered that fasting bloods were

* The negative nitrogen balances observed in certain of the atrophic arthritis cases may well have been due to an inadequate diet allowance. Certainly the daily nitrogen allowance in these cases was far less than in the one cited above.

examined. Further, a blood analysis is based upon a sample of material constantly changing its composition, and subject to a wide diversity of independent influences. A urine analysis, on the other hand, is a summation of variables, an integration as opposed to the differentiation which the blood picture may be considered to represent. Allowing this contention, the problem is still far from solution. Folin and Berglund (Jour. Biol. Chem., 51–395, 1922) have deduced a participation of all mammalian tissues in the formation of urea. Increased tissue activity, coupled with increased kidney permeability would unify the lowered blood and increased urine levels. The concept of increased tissue activity finds support in the character of the elimination curves of creatinin and of neutral sulphur—fractions generally regarded as indices of endogenous metabolism. If the kidney be the seat of ammonia formation, as suggested by Nash and Benedict (Jour. Biol. Chem., 48–463, 1922), increased acid production could explain the harmony of this substance with the general elimination curves. The significance of the blood sugar change, of a striking magnitude in several of the cases, would find explanation in the tissue absorption theory of Folin and Berglund (J. Biol. Chem., 51–213, 1922). This would imply a lessened need of transport of the readily oxidized material, coincident with the improvement of the level of tissue protein metabolism, and a subsidence to normal blood concentrations.

At best, however, these can but be suggestions. The weight of the meager evidence offered would seem to indicate a possible improvement in cellular function, conditioning a possible improvement in absorption, a probable increase in tissue metabolism, and a certain improvement in kidney permeability. Further, that these changes persist only during the period of electrical stimulation, except in those cases where an acute process exists.

The contents of this paper may be briefly summarized as follows:

SUMMARY

1. A study of the influence of the high frequency electric current, using the so-called "auto condensation" method of application, is recorded. This comprises blood and urine studies, together with the basal metabolism records of groups of normal controls and of arthritic subjects.

2. Various effects are observed, which are apparently ascribable to the influence of the electrical stimulation, and which disappear with the cessation of its use. Cases showing an acute condition constitute an exception to the above, the improvement being apparently progressive and more lasting.

3. Among these changes may be noted:
   (A) A diminution in the nitrogenous constituents of the blood.
   (B) An increase in the nitrogen and sulphur of the urine.
   (C) The general elimination by the kidneys reflects the changes shown by nitrogen and sulphur. The Phthalein test is an exception, no changes being noted.

4. The basal metabolic rate decreases during the treatment period, and only in the control group does it return to the pre-treatment level.

5. The blood sugar concentrations in the arthritic group show changes proportional to their initial level.

6. Certain speculations are offered in possible explanation of the observed phenomena.

UNCOMPLICATED DISLOCATION OF THE INFERIOR RADIO–ULNAR JOINT*

BY ALEXANDER GIBSON, F.R.C.S. (ENG.), WINNIPEG, CANADA

Several factors contribute to the security of a joint.

In some, such as the hip and ankle joints, the form of the bones is such as to resist displacement. In others, such as the shoulder, muscular co-ordination is the chief source of strength. In others, such as the knee, integrity is maintained mainly by powerful ligaments. In every joint, mobility in itself and in adjacent articulations is a source of safety; a sort of strategic retreat can be accomplished. Perhaps the strongest of all joints are those that are ligamentously strong. That is why a dislocation of these joints is rare. It may occur as a complication of fracture, but the uninvolved dislocation of a joint which depends for its strength on ligaments alone is not common if we exclude the acromio-clavicular joint. The inferior radio-ulnar articulation is such a joint and its record is no exception to the general statement made. In looking through the literature, one is struck by the frequency of the remark that few surgeons have seen more than one case. I would therefore venture to bring to your notice an instance of this accident.

The lesion is generally referred to as a dislocation of the head of the ulna. This is really a mistake in terminology. It is the ulna which is fixed; it is the lower extremity of the radius which undergoes displacement. But not only is the lower end of the radius more massive than the lower end of the ulna; it carries with it also the whole carpus and hand, so that it appears as if the ulnar head had undergone the displacement noted. Hence it is customary, although inexact, to accept the erroneous designation.

At first sight it would appear that injury to this joint might be common. It is placed at right angles to the main axis of the limb. The muscles which are in close relation to it are for the most part tendinous in this region, and they run, on the whole, longitudinally, so that they can have no direct supporting action. Posteriorly, the slender tendon of the extensor digiti quinti proprius is in direct relation to the joint. The pronator

* Presented at the Annual Meeting of the American Orthopedic Association, May, 1924.

quadratus is close to the joint anteriorly, and its fibres no doubt help to strengthen the articulation against direct distraction. Four muscles act directly upon the joint. Two of these supinate, viz., the biceps and the supinator (brevis). Pronation is carried out by the pronator teres and the pronator quadratus. The supinators are more massive than the pronators, but their power is applied more closely to the pivotal axis, which passes from the centre of the head of the radius to the pit at the base of the styloid process. Hence the moment of the force is not excessively greater, although movements of supination are relatively more powerful than those of pronation. The flexor carpi radialis and palmaris longus assist in pronation; the extensor pollicis longus in supination; the brachio-radialis assists in either movement. The joint possesses an anterior and a posterior ligament, both thin, lax and comparatively unimportant. The triangular disc, fixed by its apex to the pit at the base of the styloid process of the ulna, and by its base to the distal ridge of the ulnar notch of the radius, is the most important ligament in the articulation. Its structure is mainly fibrous. By combining rotation at the shoulder joint with radio-ulnar rotation a range of well over 360 degrees can frequently be secured. The amount of rotation occurring at the radio-ulnar joints themselves is about 135 degrees. In the mid-position the joint is most secure. Pronators and supinators can act simultaneously to bring about fixation. In extreme pronation or supination either group is contracted to the limit, while the complementary group, according to the law of reciprocal innervation, has "paid out the slack" to the fullest extent: hence the joint is at its weakest from the point of view of muscular control. In either extreme position, security depends essentially on the interarticular disc. If this be itself torn, or its attachment give way, then dislocation of the joint will occur. In forced pronation, the posterior fibres of the interarticular disc become tense; in forced supination, the anterior fibres.

On theoretical grounds, dislocation might be produced by:

(a) Force applied in an abnormal direction, *e.g.*, so as to separate the bones, or push one past the others, *i.e.*, force applied tangentially to the axis of the joint.

(b) Force applied in a normal direction but excessive in amount.

Forcible distraction of the bones is probably of theoretical interest only. I have not been able to find any recorded cases. In the case recorded herewith the force causing dislocation was applied tangentially. The question at once arises as to what force is excessive in amount. It is

obvious that a force which could easily be coped with in the position of greatest strength might be excessive in the position of greatest weakness. Hence the positions of greatest danger are those of full supination and of full pronation. Again, the further from the axis of rotation the force is brought to bear, the greater will be its moment. Hence if the point of application of force be in the neighborhood of the styloid process of the radius, its effect will be a maximum. It is further noteworthy that in the position of maximum pronation or supination the joint is robbed of one of its best defences, *viz.*, mobility.

A survey of the literature confirms the theoretical conclusions reached above, and suggests a classification of inferior radio-ulnar dislocations.

Inferior radio-ulnar dislocations:

(I) With fracture.

(II) Without fracture.

Congenital: Madelung's deformity.

Acquired:

(1) Traumatic { (a) Forward; (b) Backward—acute, chronic; (c) Inward (?)

(2) Pathological

The "acute" forms may also be classified as:

Recent
Old-standing
Recurrent

The earliest description I have come across is that by Astley Cooper in 1822. "Boyer met with a case of luxation of the ulna anteriorly which is exceedingly rare. A woman engaged in a riot was pushed out of the house by a man who twisted her hand violently in the supine direction. She felt horrible pain and cried out that her wrist was breaking, and immediately saw that a deformity had occurred. Boyer was called in; he found the hand fixed in the supine state, the forearm bent and the hand supported before the breast. The inferior extremity of the ulna crossed before the radius in a remarkably oblique direction. The reduction was accomplished only by the fourth attempt. The luxation of the inferior extremity of the ulna backward, says Boyer, has been frequently observed. As the luxation forward is produced by a violent supination, so that backwards

is the result of a violent and sudden pronation. Such was the case of a female mentioned in *Desault's Surgical Journal* who luxated the cubitus backward in wringing wet clothes—in doing which the hands are put in the greatest state of pronation possible."

In the "Leçons Orales" of Dupuytren, who died in 1835, there is a chapter on dislocations of the lower extremity of the ulna. He states that the first recorded case was observed by Desault in the body of an individual brought for dissection. He describes dislocation of the ulna on the radius, whether backwards or forwards, as of extremely rare occurrence, and says that in the course of his long practice of twenty-four years as surgeon to the Hôtel Dieu, it had occurred to him to witness only two instances of this form of injury. Both were dislocations of the ulna forwards. The first occurred in a man of 32, whose horse fell, crushing his right wrist between the horse's head and the ground. The second occurred to a builder, forty-five years of age, who was supporting with his right hand a scaffolding which threatened to fall. He felt a severe pain at the lower part of the forearm. He went immediately to consult Dupuytren at the Hôtel Dieu, and the latter diagnosed a forward dislocation of the head of the ulna.

The elaborate ceremonial of reduction in these two cases is thus described:

"To reduce this dislocation the patient was seated in a convenient position, and a sheet was passed through the right axilla and fixed to a ring in the wall; another cloth was also applied in folds around the elbow and entrusted to assistants, who were directed to keep the forearm at a right angle with the upper arm. Lastly a napkin was fastened around the wrist, by which other assistants were directed to make extension. The hand was then forcibly drawn to the radial side, whilst I made pressure with my two thumbs on the luxated extremity of the ulna in a direction inwards and backwards; and shortly afterwards the reduction was effected with an audible snap. Deformity at once disappeared and the natural movements of the arm were restored."

In 1893, Jones reported a case occurring in a colliery fitter, fifty-five years of age, who, while working at a screwing machine, was struck on the palm of the hand by a bolt which had slipped. This brought about violent pronation. (?) The clinical signs pointed definitely to anterior dislocation of the head of the ulna. Reduction was brought about with a loud snap by means of moderate extension and forcible supination of the hand. (?)

One is tempted to think that in this record the terms "pronation" and "supination" have been transposed.

In 1896 Kirkby-Thomas reported another case. A man, thirty years of age, was engaged emptying some casks on board ship. While doing so, one of the heavy iron hooks swung back and came violently into contact with the back of his forearm on the inner side. The case was diagnosed as dislocation forwards of the head of the ulna.

FIG. 1

FIG. 2

Reduction was not easy. It was effected by pressing the head of the ulna towards the inner side of the arm, at the same time flexing the hand strongly and pronating it. The bone returned to its normal position with a well marked snap.

Stimson (1900) went carefully through the cases recorded to date, rejecting all those complicated by fracture of the radius. He concluded that there had been reported altogether thirty-five cases, twenty forwards and fifteen backwards (including one by Ridlon).

In 1912 Cotton and Brickley reported a case of forward dislocation in a man of forty-five, who was engaged unloading beer kegs from a wagon. He was pushing on a keg when it slipped, the hand and radius being displaced suddenly backwards from the muscularly fixed ulna. The mechan-

FIG. 3

FIG. 4

ism of the dislocation, they conclude, may be either forced supination or a direct backward shove on the hand with the ulna fixed by mechanical impediment, or by the force of the triceps.

Since then a case of recurrent dislocation of the ulnar head has been reported by Yoder, whose report refers to other cases recorded by Hoffa (1898) and Courtin (1905). Mitchell, in 1922, described his method of treating recurrent anterior dislocation of the head of the ulna. Many other cases have been recorded in which fracture of the radius co-existed, but as far as I am aware, Cotton's case is the last on record of uncomplicated dislocation.

The question of recurrent dislocation will not be dealt with at length in the present paper.

METHODS OF TREATMENT

The elaborate technique of Dupuytren involving a multiplicity of assistants has already been described. Dupuytren refers to the cases recorded by Sir Astley Cooper, which "were in a direction backwards, which is less rare, though more serious, on account of accompanying laceration of soft parts, than the forward luxation; hence the proposition of the English surgeon to amputate in these cases." I have not been able to verify this drastic recommendation.

Cotton described Desault's method of reduction by using thumbs and fingers to separate the bones, while an assistant carries out pronation or supination. If the case be recent, reduction is accomplished with a snap and seems not to tend to recur. Cooper, on the other hand, found that "as soon as the pressure is removed, the deformity returns as the lacerated ligament has no longer the power to retain it in its place."

Probably the tendency to recurrence was because the movement of pronation or supination was not employed. This rotatory movement is the essential for maintaining reduction.

Darrach, in 1912, after an unsuccessful attempt at reduction, removed subperiosteally the lower inch of the ulna, leaving behind the styloid process which had been broken off. The result was good. In a former case, complicating fracture of the radius, exposure of the head of the ulna from the front and forcible reposition proved a comparative failure.

Mitchell removed the detached styloid process, and by means of a sliding graft fashioned a new styloid process for the ulna. It is difficult to see how this could have other than a radiologically cosmetic value, although eight weeks later the patient was discharged "with a strong and useful wrist."

Preston says, "In old cases it may be necessary to resect the ulnar head. In recurrent cases it may be possible to shorten the lower radio-ulnar ligament, or their tension may be increased by dividing the radius

about two inches from the lower end and tipping the lower fragment so that the styloid will occupy a lower level."

Stimson states, "Even in old cases—60 days—reduction has been easily made by direct pressure on the radius." In Yoder's case, "when the pressure that was needed to reduce it was released, re-dislocation occurred." Adhesive and a splint were applied. This case had a fracture of the ulnar styloid.

The following case was referred to the writer by the Workmen's Compensation Board on November 5th, 1923. The patient spoke very little English and it was difficult to get accurate details of the accident.

P. U.; age 42; laborer. Five or six weeks previously while unloading heavy pipes from a wagon, with the hands in full supination, he was struck forcibly on the left wrist by a piece of pipe which rolled off the wagon. Examination showed a swelling about the size of a hazel nut on the palmar surface of the left wrist to the ulnar side of the tendons of flexor sublimis digitorum. The swelling was soft, and not very tender. It seemed to be subcutaneous and appeared to come through the deep fascia. Its nature was undetermined. Pressure over the lower end of the radius or of the ulna caused pain. There was loss of sensation to pinprick over the fore-finger and part of the thumb, evidently from pressure on the median nerve. The wrist was held in the supinated position; no pronation was possible, movements of the wrist and carpal joints were much diminished; movements of the fingers were fair.

The radiograph showed no fracture of radius or of ulna. There was no fracture of any of the bones of the carpus.

The head of the ulna lay in front of the lower end of the radius, the whole head overlapping the radius, only the ulnar styloid being outside the radial shadow. In the radiogram the head of the ulna, the lunate bone, and the capitate made a straight line which was continued directly into the line of the third metacarpal.

On November 16th, *i.e.*, about seven to eight weeks after the accident, patient was anesthetised and at the same time the forearm and hand were prepared for operation.

An attempt to reduce the dislocation by manipulation was unsuccessful, so open exposure was decided upon. The intention was to expose the joint from the dorsal aspect in order to satisfy one's curiosity regarding the condition of the interarticular disc; then to open from the palmar aspect, investigate the swelling and attempt to replace the head of the bone.

The dorsal incision gave excellent exposure. The triangular ligament was found to have been torn away from the ulna while it remained attached to the radius.

A periosteal elevator was then inserted beneath the ulna at a point about one inch above the head, and the displaced head was levered into its normal position with the greatest ease. Realising that the torn triangular fibro-cartilage was the key to the situation, a suture was threaded on the disc; the pit at the base of the ulnar styloid was cleared of scar tissue and an attempt made to fix the ulnar apex of the disc in its normal position. The dorsal radio-ulnar ligament was then sutured and the hand put up in the position of almost full pronation with plaster of Paris.

On November 27 a window was cut in the plaster, the stitches were removed, and patient was instructed to report in two weeks for removal of the plaster. On December 11 he was again seen. Shortly after his last visit he himself had removed the hand portion of the plaster and was using the hand itself. The plaster was removed and another radiograph was taken. This showed practically a normal relationship of parts. On December 18 he was discharged with instructions to use the hand freely. The patient did not return to work until April 1, 1924, as the firm with which he was employed had no orders. The result is described as being 100%.

The exact constitution of the volar swelling remains unverified. It probably consisted of the flexor tendons pushed in a volar direction by the head of the ulna, through a tear in the deep fascia.

The dorsal route of the exposure certainly gave excellent access, and it was probably easier and safer to withdraw the ulnar head from its cicatricial bed than to push it away from the front. In addition to this, the dorsal exposure gave excellent access to the triangular fibro-cartilage for the purposes of re-attachment. By applying the leverage at a short distance from the head of the ulna, and not directly to it, the integrity of the head was preserved.

It is probable that in the case of backward dislocation the same exposure could be used.

DISCUSSION ON PAPER OF DR. GIBSON

DR. ROLAND HAMMOND, Providence, R. I.: I had never seen any cases of this condition until within a few weeks when I had two cases come into the clinic, one of the chronic variety and one acute. In the acute variety, the girl was a laundry worker, and while leaning over a revolving roller her wrist was caught and twisted in flexion. The dislocation was reduced and the arm put in a cast and the bone stayed in place

after the removal of the cast. The chronic case was of some five or six years duration. The point is that it is not easy to get the radius in position and to immobilize it. Dr. Gibson's suggestion of suturing the triangular fibrocartilage to the styloid process seems to me would work in the majority of cases. In other cases we must consider the question of bringing the ulna and radius together, even at the risk of destroying function at the lower end of the articulation. These cases, of course, must be distinguished from Madelung's deformity, though I was interested to know that in chronic cases Dr. Gibson found the lower end of the radius distinctly oblique, resembling the condition found in Madelung's deformity, rather than more nearly transverse as is ordinarily found.

TWO CASES OF RECURRENT ANTERIOR DISLOCATION OF THE SHOULDER*

BY W. W. PLUMMER, M.D., AND F. N. POTTS, M.D., BUFFALO, N. Y.

Anterior dislocation of the shoulder of traumatic origin is probably the most common of all the major dislocations. Relatively only a very small number of cases become chronic recurrent dislocations, but the resulting disability in some instances is very serious in the way of limitation of normal activities, both as to earning capacity and engagement in the ordinary athletic sports. A number of operative procedures have been in use for the cure of this condition where conservative methods have failed, and the object of this brief paper is to suggest another plan which seems to be effective and yet is very simply and easily carried out.

In the production of the primary traumatic anterior dislocation of the humeral head, several forces take part: some degree of abduction of the arm with direct or indirect force applied from behind forward, plus a fulcrum point which will tend to bring the head of the humerus downward and inward to lodge under the corocoid process. Opinions seem to differ in the matter of the fulcrum, whether it is a leverage against the acromion, or against the pull of the strong adductor muscles thrown into violent spasm. Personally I am inclined to believe that the adductors are the important factor in the production of the anterior type of dislocation. Dr. F. J. Cotton has shown good mechanical reasons why this should be true, and additional evidence is to be found in the fact that anterior dislocations have followed violence to the shoulder joint with the arm in a position at the time of injury where leverage against a bony point superior to the articulation is impossible.

In any event, tearing and stretching of the investiture of the joint in its anterior aspect results. In the great majority of the cases, reduction and proper after-treatment is followed by a nearly, if not entirely, complete recovery of function. Where recurrent dislocations follow as a sequel to this type of injury it has been assumed that a laxity of an imperfectly healed joint capsule plus a weakened deltoid muscle is the probable cause. Some writers have expressed the view that the anterior edge of the glenoid suffers a fracture at the time of the injury, or that the fibro-cartilaginous

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ligament is ruptured and the capsule torn at this point. It would seem rather difficult to be assured that only one structure should suffer permanent failure of repair in a system of ligaments so complicated as that found at the shoulder. It would be better then to assume that the whole connective tissue investiture of the joint had failed to regain its function of restraint of the head to its normal relations with the scapula, and each ensuing dislocation increases the disability.

So far as I know, all the operations proposed have been designed to correct what might be called the weakness or laxity of the structures of the antero-internal aspect of the joint. Several of these operations have been in common use and have given good end results in the way of prevention of dislocation and a useful range of motion at the shoulder. However, they have all involved a rather extensive and deep dissection in the region of the shoulder to make possible the use of muscle flap transplants or plicating suture of the capsule. In the end analysis the effect of the operation seems to be a limitation to abduction and internal rotation at the shoulder, this factor being important in the prevention of subsequent dislocations. It would appear, then, that if the humeral head could be prevented from slipping forward when pulled upon by the adductors, and a fairly free abduction permitted, the indications would be met.

The technique suggested here is for the purpose of applying a check to the antero-internal slipping of the head, and consists, in brief, of free fascial transplants to the anterior and external aspect of the shoulder joint to increase the rigidity of the capsule at this point. Case number one, to be described later, gave rise to the plan proposed. A capsulorrhaphy previously done, had given relief for only a few months. No violence was necessary in this case to produce a dislocation, but the head once out, anesthesia was necessary to replace it. Apparently a well repaired capsule was not sufficiently rigid to prevent the initial slipping which quickly became a complete dislocation.

The operation is quite simple. With the patient on his back, and the arm at the side in a position equivalent to the middle of the arc of rotation of the humerus, an incision is made just external to the greater tuberosity and in the long axis of the arm. The incision should extend well up on top of the acromion and below the surgical neck of the humerus. The fibers of the deltoid are separated, and the underlying capsule (or better, connective tissue investiture of the joint) bared and cleared to expose the anterior and external edge of the acromion. From the thigh a strip of fascia lata five or six inches long by one inch wide is dissected, divided into two narrow strips to be used for the transplants. A coarse,

full curved needle is threaded to each end of each strip. The needle on one end of the first strip of fascia is carried through all of the layers down to bone at the base of the greater tuberosity, avoiding the biceps tendon, and in a direction upwards toward the anterior tip of the acromion. The needle point emerges here and is passed through a small drill hole in the

FIG. 1. CASE 1.
Right Shoulder, June, 1922.

edge of the acromion to bring the end of the fascial strip upon the upper surface. This has taken half of the first strip. The needle on the other end of the same strip is now inserted at the base of the greater trochanter a little external to the first suture and brought up through the acromion as before. The two ends of the fascial strip are drawn tight and sewn together and to the top of the acromion with No. 1 chromic gut. The

second fascial strip is implanted in a similar manner external to the first. The wound is closed in the usual way and the arm dressed at the side in sling and thoracic binder. We have in effect now two fascial transplants to the shoulder capsule in the form of two double mattress sutures. These sutures, being short and placed as they are, tend to limit movements of

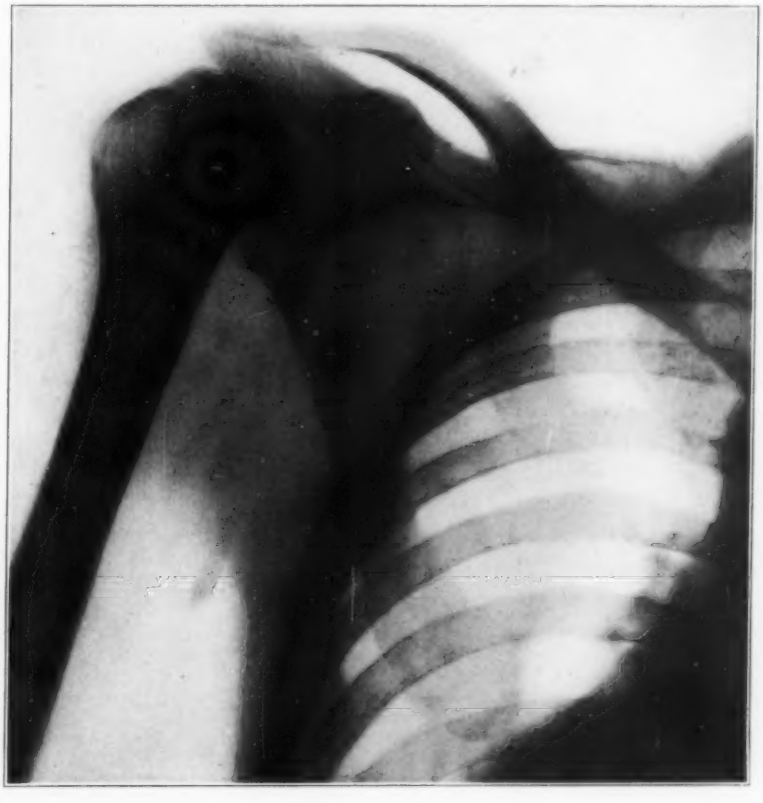


FIG. 2. CASE 1.
Left Shoulder, June, 1922.

the head; first, away from the acromion by their tension; second, rotation in both directions, for the same reason. It was assumed that abduction would also be limited due to traumatising of the subdeltoid bursa and thickening about the greater tuberosity. This limited abduction has followed in both the cases operated, but has not persisted in the degree of limitation that might have been expected.

Both patients were left in sling and binder for four weeks, with daily massage and motion of the forearm after two weeks. After the removal of sling and binder, increasing use was permitted, but a sling and binder was used at night. In both the cases the men have returned to work, and neither has suffered a relapse nor has felt anything like a sense of instability in the shoulder joint. Rotation, especially internal, is limited in both cases, but not enough to cause inconvenience. In case one,

FIG. 3. CASE 1.
Left Shoulder, March, 1924.

limitation of abduction was marked at first, gradually diminishing until now he has about seventy-five per cent of normal range. Both men have stated that they have pain-free, useful shoulders.

This plan has given excellent results in two cases of recurrent dislocation at the shoulder, and a third case, too recently operated upon to be reported here, gives promise of equally satisfactory recovery of function. If further work along these lines should prove the operation to be mechanically sound, the method is commendable for its simplicity and the resulting useful range of motion in the joint.

CASE REPORTS

CASE 1. H. M. E. Male; age 30; industrial chemist. A rather slight, not heavily muscled individual, whose previous medical history has no bearing on the present condition.

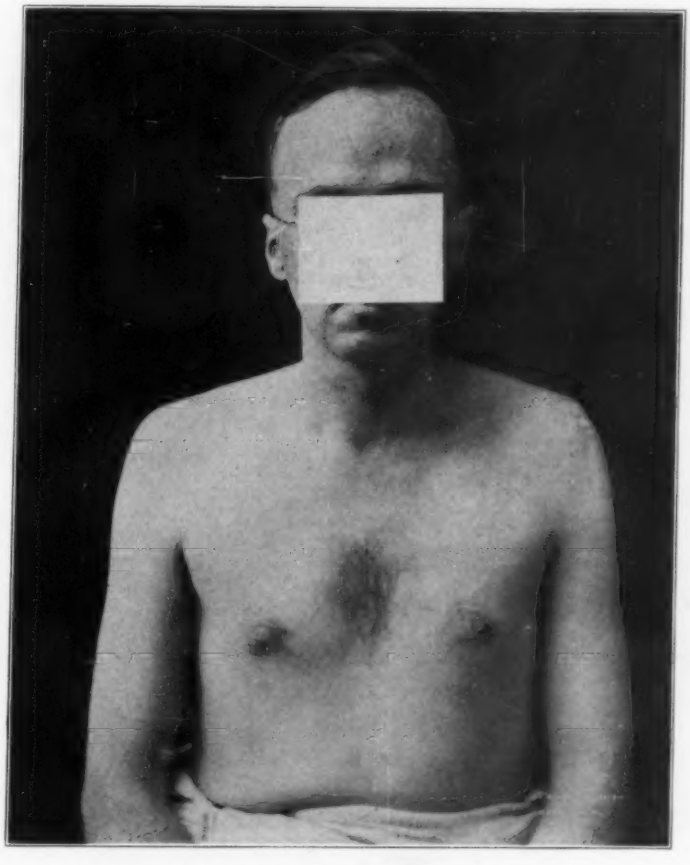


FIG. 4. CASE 1.

March, 1924, Atrophy of Deltoid

In 1917 he had a traumatic anterior luxation of the left shoulder, reduced under anesthetic and treated in the usual manner. The first recurrent luxation followed shortly after use of the arm was begun, and in the period from 1917 to 1920 about twenty dislocations took place without any marked violence, the dislocation frequently occurring while the patient slept. The dislocations during this period were reduced without anesthetic and produced only a brief disability. In 1920 a capsulorrhaphy

was done, with relief from all trouble for about ten months. Reaching for an object on a shelf resulted in a dislocation which was very painful and required gas anesthetic for reduction. During the two years following, several luxations occurred in a similar manner and all required anesthesia for reduction. He was wearing a restraining sling at night, and avoiding anything like free movements of the left arm. He was seen

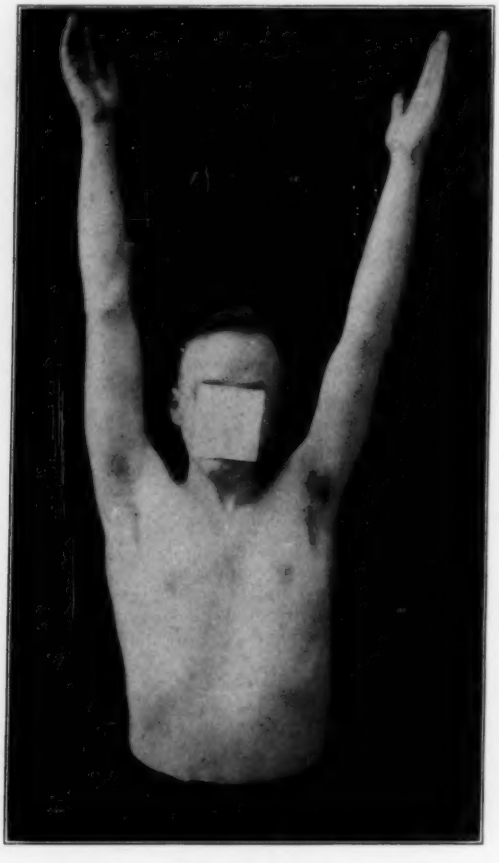


FIG. 5. CASE 1.

March, 1924, Range of Abduction.

by the writer in June, 1922. He presented a marked atrophy of the left deltoid and upper arm muscles. The shoulder joint was not sensitive, and did not seem relaxed. He would not permit passive movements of the shoulder, fearing a dislocation. Radiographs of both shoulders failed to show any pathologic changes in the left, except possibly a little bone atrophy such as might be expected from the history.

June 20, 1922. Operation as above described, followed by an uneventful recovery. Use of arm gradually increased.

May, 1923. Horizontal abduction. Rotation limited, both directions; no pain in shoulder. Has been a useful joint without dislocation.

March, 1924. Pain-free, useful shoulder, with limitation of rotation in both directions. Abduction to about seventy-five per cent. of normal range. No dislocation

FIG. 6. CASE 1.

March, 1924, Range of Abduction.

up to present time. Atrophy of deltoid persists, but no disability of importance noted.

CASE 2. O. C. Age 28; male; negro; waiter on lake steamer. Previous medical history unimportant. In 1919, while wrestling, suffered an anterior dislocation of the right shoulder, which was reduced and treated as usual. The patient was unable to

give exact data as to the first relapse, but up to July, 1923, his shoulder had been out nine times. Reduction in each instance was accomplished without anesthesia, and disability was slight. July 23, 1923, the patient appeared with a sub-corocoid dislocation of the right shoulder, which was easily reduced without anesthesia. Radiographs showed the reduction to be complete, and did not show any demonstrable pathology in the joint. Subsequent to the reduction there was free motion at the shoulder with a little relaxation of the joint, and a slight atrophy of the deltoid.

August 7, 1923. This case was operated upon in the manner described above. Recovery from operation uneventful.

September 13, 1923. Patient left hospital with limitation of motion in rotation and abduction, and was instructed to limit the use of his arm.

October 17, 1923. Patient reported that he had been at work on board ship for three weeks. Arm useful and free from pain. Limitation of motion as before.

April, 1924. There has been no dislocation up to the present time.

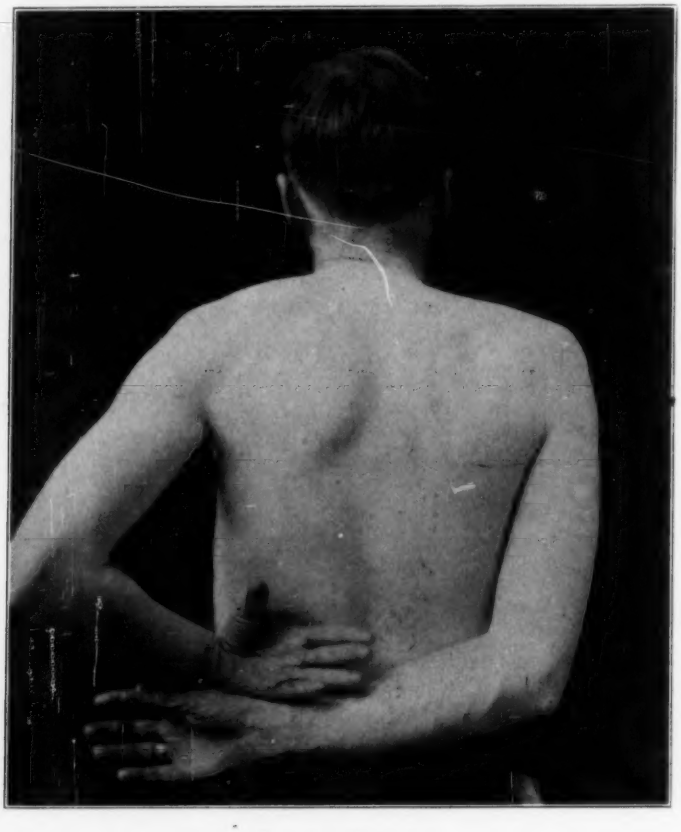


FIG. 7. CASE 1.
March, 1924, Shows Limit of Internal Rotation.

A CASE OF ANOMALOUS SPINAL DEVELOPMENT ASSOCIATED WITH LOCALIZED TWELFTH THORACIC NERVE SYMPTOMS

BY HERMAN W. MARSHALL, M.D., BOSTON, MASS.

The patient whose history and spinal radiogram are recorded in this paper is a thirty-year-old mechanic who sustained a definite injury to the lower region of his back, and his various experiences present numerous sides of interest.

The winter top of a Dodge automobile, weighing approximately 500 pounds, toppled toward him, and in attempting to hold it he strained his back muscles. His back was strapped immediately, with considerable relief, so that he continued at work for several days before painful symptoms became too severe to permit continuance at his occupation.

Roentgenograms were taken at this time, and the report of the roentgenologist dwelt mainly on the matter of asymmetry at the sacro-iliac level of the spine, where clinically at first there was most tenderness. Additional roentgenograms were taken eleven months after the accident, and the significance of a bony anomaly at the level of the first lumbar vertebra was then first taken into consideration.

The patient has passed through the care of several physicians since his accident. His bony spinal peculiarities had never bothered him previously in active war service or at any other time before his injury.

The anomalous bony development which has been responsible for twelfth thoracic nerve symptoms is an unusually long process on the right side of the first lumbar vertebra. It has the appearance in the roentgenogram of an unusually developed transverse vertebral process, except that it appears definitely jointed at its base, and so may be classified as a supernumerary rib.

The tip of this transversely directed extra rib has squeezed at irregular intervals the mass of soft tissues interposed between itself and the twelfth rib, including the twelfth dorsal nerve at a point where it lies protected on the under side of the twelfth rib. Acute painful symptoms and localized muscle contractures have resulted in a manner that will be described below. In passing, notice may be called to the presence of six lumbar vertebrae, but no clinical significance has been attached to their unusual number.

History

The history of the patient's symptoms and the treatment will be explained as they occurred.

His back was strapped after he was hurt, and he tried to continue work because he was in urgent need of money, but he was obliged to give up after a few days. Then he responded well several weeks later when a long steel back brace was used to immobilize his back much more completely, and he returned to light labor again about three months after the original injury, with his back supported in a brace which definitely lessened the range of spinal motions at lower lumbar levels, but which did not prevent a compensatory increase in range of movements at upper lumbar levels of the spine. The new job which he was given did not necessitate much lifting, but it did require continual stooping from an erect posture in order to pick up tools from the floor; and on account of the nature of his occupation he used the unrestricted part of the upper lumbar spine to an unusual degree.

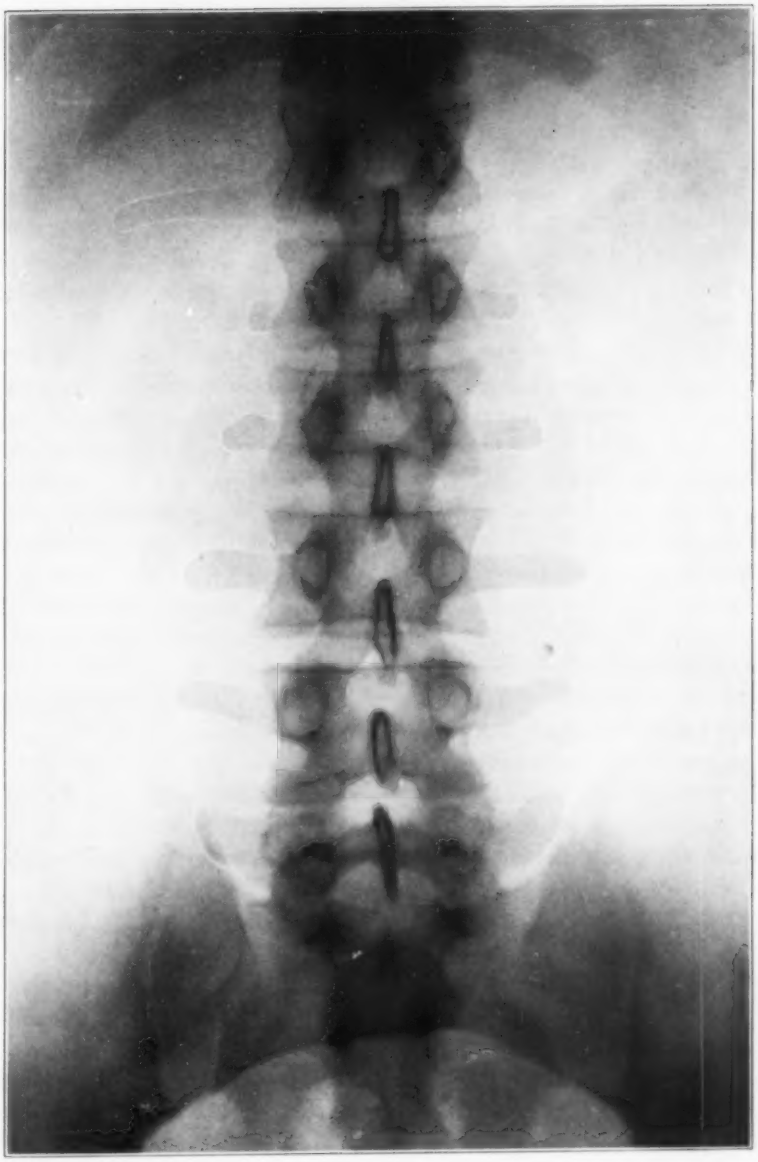
Most acute tenderness at first was at the sacro-iliac and lumbo-sacral regions, but also there was some muscle spasm and some tenderness to pressure diffused upward in the erector spinae muscles to the lower dorsal region of the spine.

Soreness in the lumbo-sacral and sacro-iliac levels had diminished markedly before he was allowed to resume work, and symptoms continued to diminish steadily in these localities with the aid of the supporting back brace; but simultaneously symptoms began to increase slowly and irregularly at the dorso-lumbar juncture of the spine, especially on its right side.

At this time there was no knowledge of the existence of the supernumerary rib because no mention had been made of it in the original X-ray report and because the radiogram was not seen personally by the orthopaedic surgeon who fitted the support.

The patient found that he could stoop over without pain if he bent laterally away from the right side, where later the extra rib was found to be located. Unconsciously he adapted himself to existing circumstances and managed to remain at work a good share of the time that intervened before the bony anomaly was definitely associated with his symptoms.

During this period while he was working he went at times for two or three weeks without any acute symptoms, and he appeared to be progressing unusually well when, without warning and in a manner he could not describe, he would be seized with very sharp pain that was referred to the region of the right hip.



These acute attacks were considered for awhile at first to represent some obscure slight slipping of bones, but as time passed there was recognition that they did not harmonize well with the idea of sacro-iliac subluxation. Muscle spasm and local tenderness were steadily subsiding in the latter region while the patient began to complain of a "bunch" which he said came out higher up at the dorso-lumbar juncture. This bunch always disappeared before an examination could be made, but it was tentatively diagnosed as a localized muscle cramp of obscure origin.

The influence of local massage and local applications of radiant heat were tried before the extra rib was identified, but only two treatments were given then because they produced severe pain in an unusual manner, which lasted several hours before it completely subsided.

The administration of aspirin apparently produced unusually prompt and complete relief. The patient carried aspirin tablets in his pocket while at work and took them whenever he experienced an acute attack. In fact, he overdid this and was taking as many as a hundred five-grain tablets a week before it was discovered how many he was consuming.

Intervals between acute attacks seemed to grow longer but the acuteness tended to grow more intense, and finally additional roentgenograms were taken. The extra rib was immediately thought by the writer, after personal inspection of the films, to be the cause of the symptoms, and an operation for removal of the protruding supernumerary rib was advised.

Operation was opposed by the patient at the time; also it was not favorably considered by the insurance company which was paying for medical care. Another orthopaedic surgeon was consulted, who was of the opinion that the extra rib was not the cause of the patient's symptoms, and he advised less protection for the back and recommended a vigorous course of baking and massage. This treatment was carried out; but, as before, there was marked increase of painful symptoms while treatments were actually being received; then there was a subsidence of acute pain until the next treatment. Finally these treatments were abandoned and another back support was made for the patient.

During the second year of the disability, while the patient was still receiving bakings, the writer received an emergency call one Sunday afternoon and heard the following unusual history.

The patient had been sitting quietly at a table writing a letter when he was seized with an excruciating pain in back, hip, and side. He attempted to stand up, but fell to the floor. He stated that an unusual bunch had come out in his side in a manner that had never happened before. The region included by this transitory tumor was larger than it had been previously.

He had managed to get into a plaster jacket which he had fortunately kept, and, having dosed himself freely with aspirin, he was fairly comfortable when the writer arrived. An examination was made on the next morning, but it showed nothing new.

There was no marked rigidity of erector spinae muscles of the lumbar region; there was very little tenderness at sacro-iliac and lumbo-sacral areas; and there was no localized muscular contracture or markedly increased muscular tension in the muscles supplied by the right twelfth dorsal nerve.

This last dorsal or twelfth thoracic nerve is larger than other dorsal nerves, it should be recalled. Its anterior division runs along the lower border of the last rib and then forward in the abdominal wall between transversalis and internal oblique muscles toward the mid line of the abdomen. Together with the other lower dorsal spinal nerves, it helps to supply muscles of the abdominal wall. One of its branches helps to supply the thin serratus posticus inferior muscle that is situated at the dorso-lumbar level of the spine, stretching from spinous vertebral processes in the dorso-lumbar region across diagonally to points just beyond angles of the last four ribs. The lateral cutaneous branch of the twelfth dorsal nerve is remarkable for its large size. It perforates the internal and external oblique muscles, and then runs downward over the crest of the ilium as far as the trochanter of the femur.

The location at which the patient indicated he felt the phantom tumor come out in his back and side corresponds accurately with the position of the serratus posticus inferior muscle and with nearby muscular tissue of the lateral aspect of the abdominal wall which is supplied by motor filaments of the twelfth dorsal spinal nerve.

There was found on examination a small tender point located where the lateral cutaneous branch of this twelfth nerve normally emerges through muscles of abdominal walls; also another tender point was located at the crest of the ilium in the course of the cutaneous branch of the nerve downward over the latter toward the femoral trochanter.

There were no abnormal herniae, permanent tumors, nor appreciable defects in the abdominal wall at the region he claimed the transitory bunch had appeared and disappeared. An examination by Dr. A. H. Crosbie of Boston excluded the kidney as a possible obscure cause of the symptoms. Confirmatory opinions of a neurologist and another orthopaedic surgeon were sought concerning the case. Dr. J. W. Courtney of Boston and Dr. Charles F. Painter of Boston both expressed opinions which harmonize with the writer's views.

The only rational explanation that can account for the entire situation seems to be that the twelfth thoracic spinal nerve was subjected to transitory harmful pressures at irregular intervals, and that it responded with transitory motor and sensory symptoms in the regions of its distribution. The only adequate explanation for such sharply localized harmful pressure on the affected nerve must be based on the presence of the transversely directed anomalous supernumerary rib at the first lumbar vertebra.

At the time of the severe acute attack which has been described the young man was bent over a table and inclined to the right side busily writing. This posture would almost inevitably cause squeezing of soft tissues between the twelfth rib and the anomalous extra rib.

The fact has to be taken into consideration also that normal function of the affected nerve had become relatively unstable and easily upset through repeated squeezings in the past, as well as from painful bakings, and perhaps from over-dosage with aspirin. The nerve had reached a state in which mild continued pressure exerted on it in the unfavorable sitting posture was sufficient to induce finally a sudden explosive reaction. Or possibly the acute symptoms were precipitated by some slight unappreciated change in posture which abruptly brought the nerve more directly in line of pressure between the two opposed bony surfaces of the twelfth rib and the tip of the anomalous rib.

The ultimate outcome of this patient's trouble has been as follows: He was lost sight of after the insurance company finally paid him a lump sum in settlement, but recently, three years and nine months after his original accident, he has reported by letter that he is working as a carpenter's helper, lifting heavy doors and panels. He is still in possession of his supernumerary rib.

He states that his back still aches while he is at work, and that by the end of the day often his back becomes very sore. His right hip is still painful. He ceased to wear a back support about three years and four months from the time of original injury, and the last time he experienced muscular cramps was three or four months before he discarded his brace. He states in this last attack that the bunch came out for two hours steadily and then stopped suddenly, and during this time the pain was very bad.

COMMENTS ON THE CASE

Dr. Joel E. Goldthwait of Boston was the first to call attention to the fact that abnormally long transverse vertebral processes on first lumbar vertebrae may interfere at times with adjacent ribs and produce back symptoms, and this case which presents an anomaly simulating such an

abnormal transverse lumbar vertebral process helps to support his contention.

The matter of brace fitting for persons with low back symptoms who also possess unusual lumbar transverse vertebral processes takes on new interest from the apparent influence which one back support exerted which was used with this patient. The brace in question was designed to hold lower lumbar and pelvic regions adequately, while at the same time sufficient freedom was afforded at upper lumbar levels to enable the individual to continue at fairly active work. In the presence of abnormally long transverse processes of first lumbar vertebrae back supports should be so designed that they will not produce harmful squeezing of soft tissues at the dorso-lumbar level of the spine, where movements must take place to a greater extent when lower regions are restricted in motions.

The question of the advisability of an operation in this individual case as well as in any others of similar nature needs to be decided. This particular young man happened to encounter a series of misadventures which are responsible for the outcome of his treatment to a certain degree. He began by aggravating his condition through keeping at work as much as possible, and presumably he induced the chronically irritated state of the affected twelfth dorsal nerve by unwittingly squeezing it while wearing a special brace. Then, naturally enough, he became discouraged and undermined his health with overdosage of aspirin, by excessive smoking, and later by drinking considerable moonshine whiskey. An excessive amount of physical therapeutic measures perhaps helped to complete the work of putting the abused nerve into a highly irritable and abnormal state.

Presumably if he had undergone the operation which was advised at the end of the first year of his troubles, he would have recovered completely by the present time; but how long recovery would require without these misadventures cannot be told. Complete recovery without operation may be a possibility in the future. He is slowly improving now, and he may become entirely strong again at some future date, but improvement seems almost certain to be a slow process.

A KNEE STRAIGHTENING DEVICE

BY LEMUEL D. SMITH, M.D.

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There are numerous devices for straightening knee-flexion contractures, most of them good, some of them excellent in their provision for correcting or preventing the posterior subluxation of the joint that so frequently accompanies a long continued contracture or complicates the effort to correct it. But many are either so cumbersome, or complicated in their mechanism, that they require a rather nicer anatomic and mechanical concept than the average nurse possesses for their daily adjustment. Many that are good in other respects are quite expensive, but the worst fault in most is that, while they frequently correct the flexion and subluxation, they furnish no opportunity for mobilizing the joint during the process of straightening.

In view of the above shortcomings it has been the practice at the Children's Hospital to employ plaster cylinders and wedging, but this method has its obvious disadvantages.

We have devised an apparatus which we believe overcomes some of these difficulties. The deforming force is the contracted hamstrings, whose insertion is, of course, distal to the joint, and in many cases the contracture is so great that the head of the tibia is displaced posteriorly on the articulating surface of the femur.

An effort to straighten the leg makes a lever of the tibia with a fulcrum at the insertion of the hamstrings, (*a*) (Fig. A) tending to force its proximal end posteriorly.

Application of the correcting force to the tendons or at their insertion would be mechanically correct. Fig. B is a schematic representation of the action of the correcting forces exercised by the simplified final model, Fig. C. We have tried to apply this force by a device of light pliable strap iron held in place by laced canvas calf and thigh stockings. It will be obvious that any force exerted between the uprights (*c*) and (*c'*) will tend to lift the whole system below and distal to pivot (*b*), but since (*c'*) is a lever with an arm engaging lever (*d*) at (*e*) the tendency must be to force the upper end of the lever (*d*) in the direction of the arrow, *i. e.*, against the point of application of the deforming force. As this contracture is overcome, the whole system below (*b*) approaches a straight line. By making

Fig. A

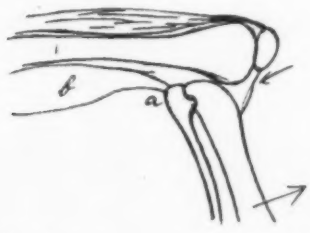


FIG. A

The tendency of the contracting hamstrings (*b*) is to subluxate the tibia posteriorally and proximally on the femur.

Fig. B

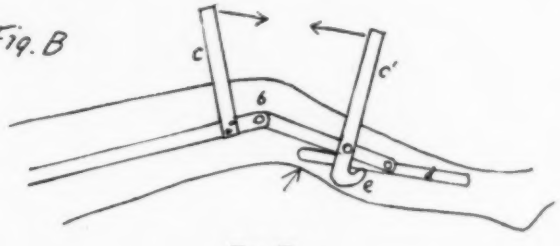


FIG. B

It is seen that the effective corrective force is at the arrow in the direction it points.

Fig C

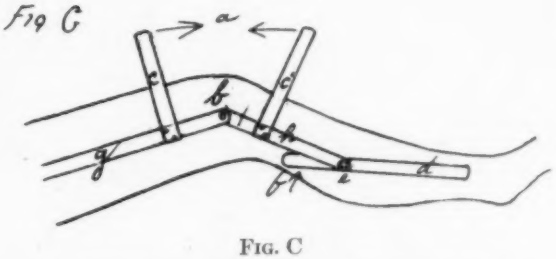


FIG. C

This is identical with B in the application of mechanical forces, but simpler and cheaper in construction.

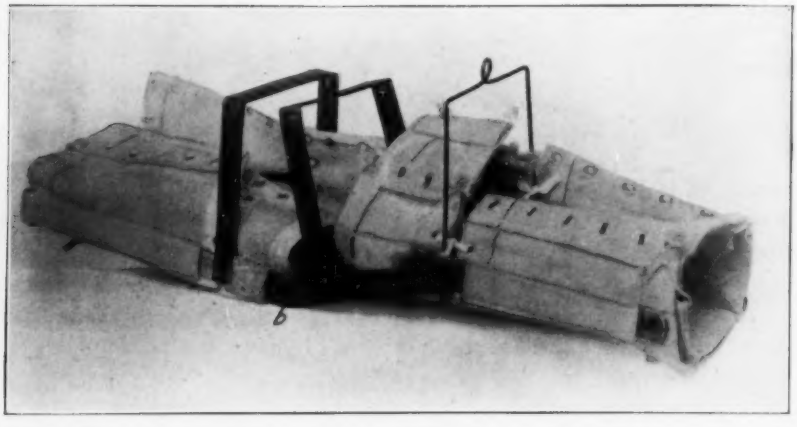


FIG. D

The device is laced on the leg over cotton or other padding. The rivet (*b*) is centered over adductor tubercle.

FIG. E

A case of Still's disease. The knees and hips were practically immobile in the positions shown.

use of a well established mechanical principle, this problem may be met very simply. If one attempts to lift a beam from a point eccentric to its centre, that end toward which the lifting point is displaced will have the greatest excursion, *i. e.*, the lifting force is more effective as we approach the end. Therefore, strap iron (*d*) (Fig. C) becomes a lever with fulcrum (*e*) (contact point of arm of lever (*c'*) in Fig. B) forcing its proximal end anteriorly and applying this force calculated to overcome the subluxation

FIG. F

Same case as Fig. E, after three weeks stretching, and showing the routine set up. Mole skin is applied to the skin for horizontal traction. Counter weights are applied to the feet to overcome external rotation.

of the head of the tibia at the most mechanically effective point near the insertion of the hamstrings. This force acts continuously and automatically whatever the angle of flexion. Further, the correcting force (*a*) being light rubber tubing (we use Dakin's tubing), the patient is able to bend the knee whenever the tension caused by the device becomes irksome. In practice he does this frequently, to the great advantage of his joint structures. In case motion is undesirable, a turnbuckle may be substituted for the rubber tubing.

The arrangement shown in Fig. C is duplicated on the other side of the leg, and arms (*c*) and (*c'*) are each one piece of strap iron bent at right angles at the top. The measurements are simple. Arm (*g*) is about the distance from the groin to the adductor tubercle. This is the only measurement necessary, besides the circumferences for the canvas leggings and the width across the knee for the width of upper part of arms (*c*) and (*c'*). Arm (*d*) is the same length as (*g*), pivoted one-third its length, and

FIG. G

Fig. G taken the same time as Fig. F, to show motion possible with the device on.

hung one-fourth the length of (*g*) distal to it, which, of course, gives distance between centers in (*h*). Arms (*c*) and (*c'*) are a little higher than one-half the length of (*g*), placed one and one-quarter inches from pivot (*b*). Pivot (*b*) should be concentric with the adductor tubercle.

The cost of this apparatus in the orthopaedic shop at the Children's Hospital is three dollars and fifty cents. The assembled device is shown in Fig. D. The apparatus has been used in correction of flexures due to osteomyelitis, tuberculosis, and polyarticular arthritis (Still's disease), with satisfactory results. Fig. E shows a child with Still's disease with the

knees and hips practically fixed in the position shown. Fig. F shows the legs three weeks after the stretchers have been applied. In Fig. G, taken at the same time as Fig. F, it was attempted to show the range of motion possible with the apparatus on.

Other appliances devised for the same purpose are —

Appareil de Bonnet pour mobiliser le genou.
Orthopédie Indispensable, Calot.
Kniestreckmaschine, Von Strohmeyer.
Kniestreckmaschine, Von Quaas.
Kniestreckmaschine, Von Burow.
Schienenhülsenapparat mit Kniestreckfeder, nach Schanz.
Subluxationsschiene, nach Hoffa.
Vorrichtung zur Korrektion von Kniekontrakturen mit Subluxation des Unterschenkels, nach Heather-Bigg.
Reduktionsapparate, nach Eschbaum.
Handbuch der Orthopädischen Chirurgie.—Joachimsthal.
Mobilisierungsschiene für Kniegelenk, nach Schede.
Lehrbuch der Orthopädie.—Lange.
Turner's appliance. Orthopedic Surgery of Injuries.—Sir Robert Jones.
Schaffer's appliance—Selected Essays on Orthopedic Surgery.—Schaffer.
Roberts' extension knee splint.
Young's extension brace. Orthopedic Surgery.—Young.

A GENERAL UTILITY INCISION FOR EXPLORATION OF THE KNEE JOINT

BY ARTHUR KRIDA, M.D., F.A.C.S., NEW YORK

Assistant Surgeon to Out-Patients, Hospital for the Ruptured and Crippled; Consulting Orthopaedic Surgeon, U. S. Marine Hospitals, New York, and North Hudson Hospital, Weehawken, N. J.

This incision of the knee joint permits adequate exploration of the joint without transverse section of the extensor apparatus or splitting the patella. It was developed in conjunction with the surgical approach for step operations on the femur[1], and has been found perfectly satisfactory in a number of cases.

With the limb extended, the incision begins four inches above the patella in the line between the rectus femoris and vastus internus, passes downward to within one-half inch of the superior border of the patella, then sweeps inwardly around the patella about one-half inch from its inner border, then downward to the tibial tubercle. The joint is entered alongside the patella, and the capsule and intermuscular junction is split with a scissors to the upper border of the quadriceps pouch, a small section of the rectus femoris tendon being left attached to the vastus internus. The incision is similarly extended downward alongside the patella tendon to the tibial tubercle.

The quadriceps pouch is then explored, after which the patella is dislocated outside the external condyle and the joint flexed to 90 degrees, when the rest of the joint cavity becomes visible. It may sometimes be necessary to partially split the infra-patellar pad of fat to fully explore the external compartment.

The synovia is sutured with 00 chromic catgut, and the capsule and tendinous planes with No. 1 chromic. The skin incision is closed with black thread. The knee is bandaged with a compression bandage over thick non-absorbent cotton. Some movement is usually allowed on the fifth or sixth day, the range increasing as pain subsides.

[1] A Surgical Approach for Step Operations on the Femur. Journal of Bone and Joint Surgery, July, 1923, Vol. V, No. 3, p. 484.

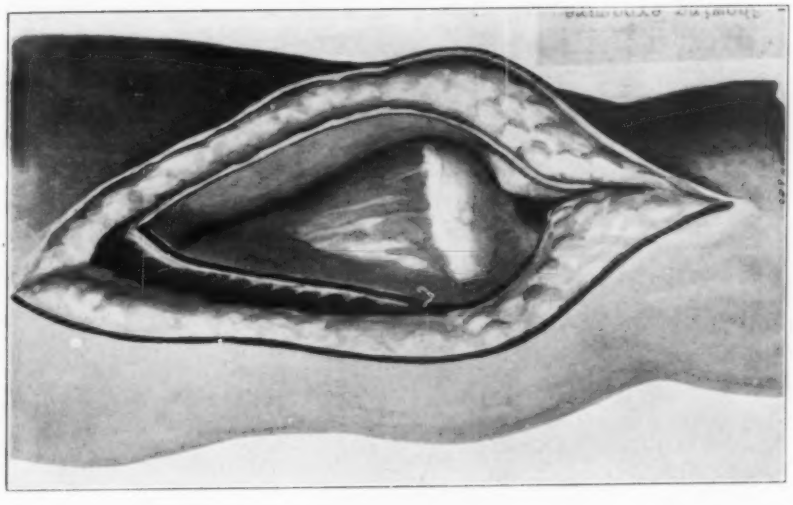


FIG. 2. Showing exposure of the quadriceps pouch.

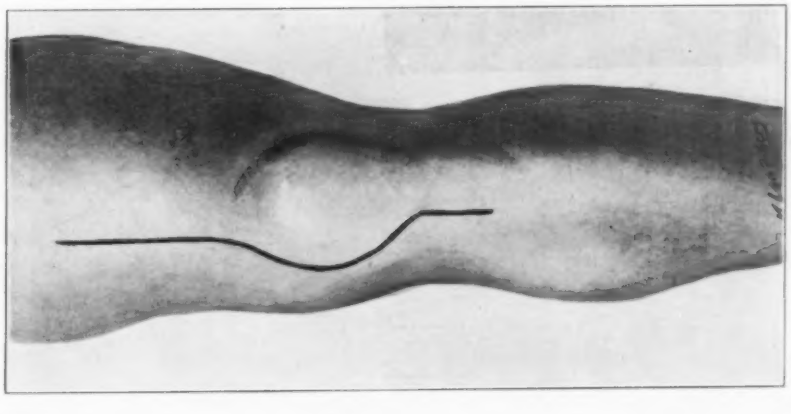


FIG. 1. Skin incision.

FIG. 4. Showing exposure of the joint after displacing the patella and flexing to 90 degrees. This sketch was made from an early case of arthritis deformans with enlarged and fatty synovial fringes.

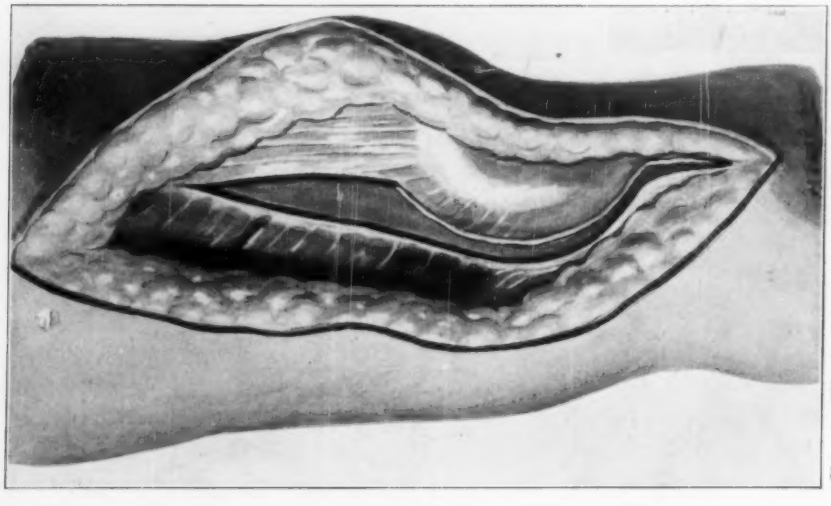


FIG. 3. The incision alongside the patella tendon.

DESCRIPTION OF INSTRUMENT FOR WEDGING CASTS

BY ALBERT E. FLAGSTAD, M.D., ST. PAUL

The block or tongue blade method of wedging casts for correcting flexion deformities has been used quite extensively in our work.

Recently we have constructed an instrument to take the place of the method formerly used. We have found it to be superior to the tongue blade or block method, briefly because

1. It is easily applied and not so cumbersome as blocks or tongue blades.
2. By means of the turnbuckle, spreading can be quite accurately controlled.
3. Only one person is required to make adjustments, which is simple and time saving.
4. As much force can be applied as necessary; daily, or twice daily, adjustments can be easily made.
5. When once applied, it will remain in place and the correction is always held; there is no danger of its slipping or coming loose.

The instrument consists of two bars of spring steel, one-eighth by one-half inch, with a good one-quarter inch space between. One end of the bars is turned to form a lip, five-eighths inch deep; a second lip, the same depth and one and one-half inches wide, is made to move on the bars by means of a one-quarter inch adjusting screw. The instrument is very simple and easily made. It will fit most any flexion deformity, even greater than a right angle, which is very rarely treated by wedging.

The lip side is placed toward the cast, the lips fitting into the edges of the slit in the cast between sheet-wadding and plaster. Occasionally it is necessary to insert a small block of metal or wood to keep the adjusting screw away from the cast. After the instrument is inserted, a bandage is placed around the cast and the instrument, with only the turnbuckle exposed. This holds the instrument in place more firmly, without interfering with adjustments.

Several precautions must be sounded:

1. Too rapid spreading should be avoided.
2. Slit should be made at least three-quarters way around cast.
3. Abundance of sheet wadding over bony prominences.
4. Watch circulation.

The accompanying photographs make the description of the instrument more clear.

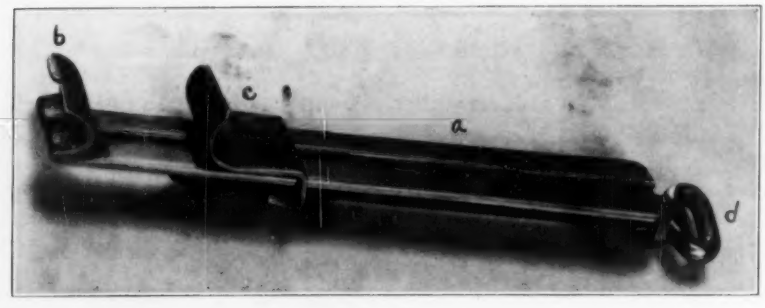


Fig. I. Anterior lateral view cast side.
a. Bars of spring steel ⅛ x ½ inch.
b. Lip of bars.
c. Sliding lip.
d. Turnbuckle.

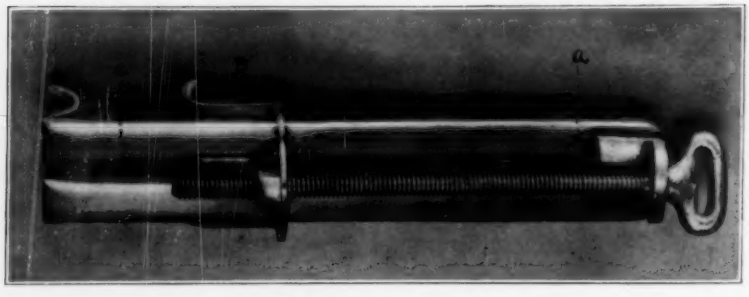


Fig. II.
a. Adjusting screw.
b. Sliding lip.
c. Space between bars.

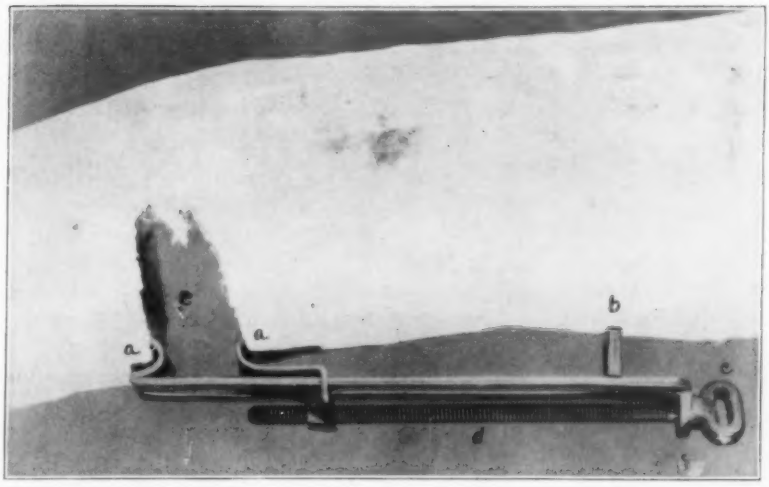


Fig. III. Instrument applied.

a. Lips in place.
b. Block of steel keeping turnbuckle away from cast.
c. Turnbuckle.
d. Adjusting screw.
e. Cast showing slit already spread.

I wish to acknowledge my thanks and appreciation to Mr. L. D. Farley, our brace maker, for his interest and help in the making of this instrument.

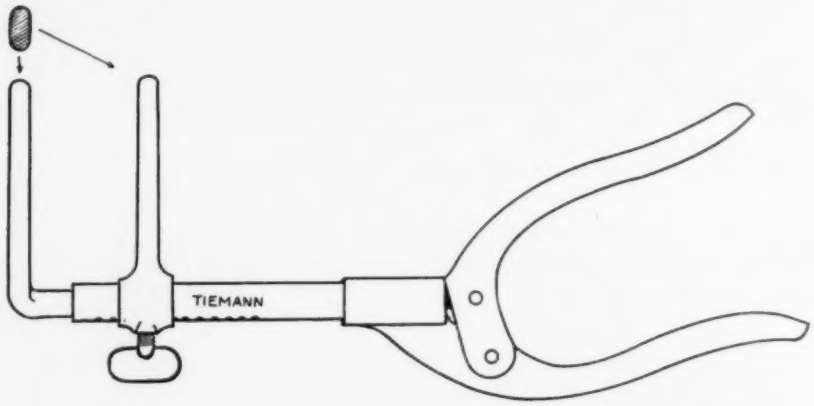
A WRENCH FOR THE TREATMENT OF CERTAIN TYPES OF COLLES' FRACTURE

BY HERBERT T. WIKLE, M.D., BROOKLYN, N. Y.

There are two types of Colles' fracture that have always been a problem in treatment:

1. Those that have been impacted by falling with great force upon the outstretched hand;

2. Those that have not been reduced, or only partly reduced, and have remained in this condition long enough for fibrous union and sometimes bony union to take place.



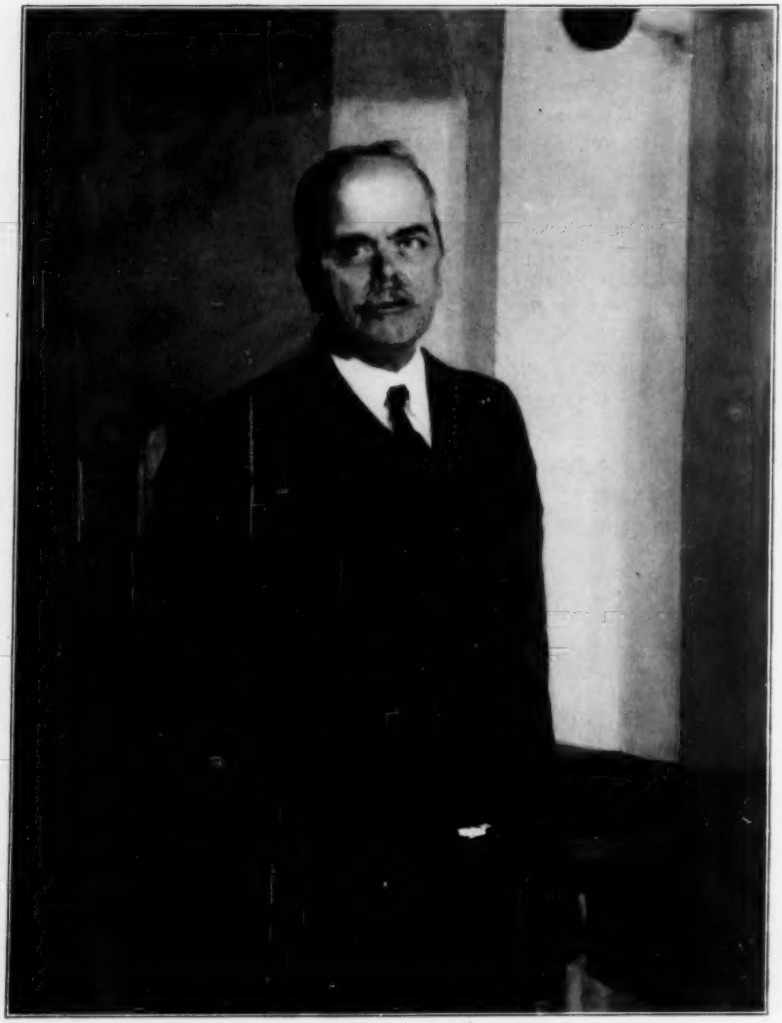
The problem, of course, is that of disengaging the fragments. This I have been doing by using an ordinary long-jawed monkey wrench that was well padded, after which the usual manual procedure for the reduction of uncomplicated Colles' fracture may be accomplished. The Thomas club foot wrench[1] would have answered the purpose better, but this was not available at the time the reductions were required.

The wrench illustrated in this article is one I have devised to meet the problems already mentioned in the reduction of certain types of Colles'

[1] Jones and Lovett: Orthopaedic Surgery, pp. 415-416.

fracture, but I see no reason why it cannot be used in orthopaedic surgery where a Thomas wrench is indicated, or in other fractures where it is necessary to disengage the fragments, as in metacarpal and metatarsal bones, where the wrench can be applied to accomplish this purpose. The jaws of the wrench are oval in shape and covered with thick rubber to minimize the trauma to the soft tissues. The wrench is applied to the distal fragment by adjusting the lower jaw with the thumb screw as illustrated. After the jaws of the wrench are applied as snugly as possible, the handles are grasped, and, by pressing these together, a firmer grip upon the fragment is obtained, and it is hyperextended until the impaction or union is broken up. The remainder of the operation is the manual manipulation of the fragments and application of a molded plaster splint as used in any uncomplicated Colles' fracture.

It must be remembered that this is a wrench where a great deal of pressure may be produced upon the soft tissues when the handles are squeezed together, so care should be taken not to continue the pressure over a very long period. The pressure is very easily relieved by simply relaxing the handles of the wrench. The wrench is easily taken apart and sterilized when it is necessary to use it in a sterile field.



EDWARD HICKLING BRADFORD, M.D.

From the original portrait just painted by Mr. I. M. Gaugengigl, which is to be presented to the Harvard Medical School by Dr. Bradford's former pupils.

News Notes

Fourteen physicians in Minnesota, interested in bone and joint surgery, have formed the Minnesota Orthopaedic Club, with the expectation of holding three or four meetings a year. Dr. Von Der Weyer, of St. Paul, has been appointed Secretary temporarily of the Club.

Dr. Herman W. Marshall, of Boston, has recently died at the Boston City Hospital as the result of injuries sustained a few days previously when he was knocked down by an automobile. Dr. Marshall was a graduate of the Massachusetts Institute of Technology and of Harvard Medical School and was engaged in the practice of orthopaedic surgery in Boston.

Dr. James William Martin has been appointed to the staff of the Creighton University Medical School and has opened an office for the practice of orthopaedic surgery in the City National Bank Building, Omaha, Nebraska.

The Radiological Society of North America held its Tenth Annual Meeting on December 8 to 12 in Kansas City, Missouri.

Of special interest to orthopaedic surgeons was the Clinical Conference on Bone Tumors, conducted by Dr. Henry W. Meyerding, with papers on Bone Syphilis, by Dr. Willis C. Campbell; on Pathologic Types of Bone Tumors, by Dr. William C. MacCarty; and on Multiple Myeloma, by Dr. Meyerding.

On Thursday, December 11, Dr. Charles G. Sutherland read a paper on Charcot Joints, and a Roentgenographic and Orthopaedic Clinic was conducted by Dr. Preston M. Hickey and Dr. Frank D. Dickson.

On the afternoon of December 12 papers were presented by Dr. Sherwood Moore on Radiological Aspects of Certain Bone Marrow Diseases; by Dr. William E. Costolow on Radiation Treatment of Bone Tumors; by Dr. Jefferson D. Southard on X-Ray Treatment of Bone Tuberculosis, and by Dr. Joseph Colt Bloodgood on Interpretation of Roentgenograms of Central Lesions of the Lower Jaw.

The section in Orthopedic Surgery of the New York Academy of Medicine held its first meeting of the season on Friday evening, October 17, 1924. The following programme had been arranged:

Presentation of Patients, and Demonstration of Instruments. (From Bellevue Hospital)

(*a*) Dislocation of 4th cervical vertebra: quadruplegia. Reginald H. Sayre.

(*b*) New Splints for Volkmann's Ischemic Paralysis. Fenwick Beekman; J. C. Burch (*by invitation*).

PAPERS.

(*a*) "Errors in orthopaedic diagnosis." Illustrated by lantern slides. Reginald H. Sayre.

(*b*) "Congenital Club-foot; its treatment together with some complications." J. Torrance Rugh, Philadelphia (*by invitation*).

The second meeting of the season was held on Friday evening, November 21, 1924, with the following programme:

PRESENTATION OF PATIENTS AND REPORTS OF CASES. (From Post Graduate Hospital.)

(*a*) Reconstruction operation of hip joint.

(*b*) Internal derangement of knee operated through split patellar incision. Elmer P. Weigel (*by invitation*).

(*c*) Post operations—Torticollis—3 cases. Charles Ogilvy.

(*d*) Reconstruction of hip following non-union. Frederick H. Albee.

PAPERS OF THE EVENING.

(*a*) "Tendon transplantation." With lantern slides showing results. Leo Mayer.

(*b*) "Consideration of mechanics of weak and flat feet." George Anopol (*by invitation*).

A third meeting was held on the evening of Friday, December 19, 1924, when the programme was as follows:

PRESENTATION OF PATIENTS, CASE REPORTS, AND INSTRUMENTS. (*From Long Island College Hospital.*)

(*a*) 1. New club-foot wrench.
2. New pelvic rest.
3. New bone-drill.
4. Chisel.
5. Apparatus for reducing congenitally dislocated hip. David Telson (*by invitation*).

(*b*) Five interesting cases of bone tumor. Herbert C. Fett (*by invitation*).

(*c*) Six cases of obstetric palsy: conservative treatment. Joseph B. L'Episcopo. (*From Kings County Hospital.*)

(*d*) A case of pathological dislocation of the hip, of unusual interest. Charles Dwight Napier. (*From St. Mark's Hospital.*)

(*e*) Report of fifteen Lorenz bifurcation operations: pre- and post-operative X-Rays: Patients. Dexter D. Ashley. (*From Newark City Dispensary.*)

(*f*) 1. Three cases of congenital spinal deformity.
2. Congenital deformity of all extremities.
3. Extreme congenital club-foot: showing the results of treatment.
4. Fracture of the head of the humerus: post-operative result.
5. Club-foot brace for night use (original).
6. Tendon-transplantation for poliomyelitis. Carl R. Keppler.

(*g*) Cases illustrating the paper of the evening, under treatment.

PAPER

"The treatment of Severe Metabolic Arthritis." Sidney A. Twinch.

The Inter-Urban Orthopaedic Club met with Dr. Plummer in Buffalo on October 31 and November 1. On Friday morning the members were entertained at the Children's Hospital by members of the staff, who showed interesting cases, particularly of the end-results of cases of spastic paralysis treated by the Stoffel operation.

In the afternoon a similar program was given at the Buffalo General Hospital, where cases and results were shown, and in addition there was given a very interesting presentation by Dr. Benjamin Roman on distemper in dogs, with lantern slides. This was particularly interesting to the members because of the bearing it has on infantile paralysis.

On Saturday the members were taken to the Adam Memorial Hospital at Perrysburg for inspection of the hospital and the methods and results of heliotherapy in bone and joint tuberculosis. The members also had an opportunity to watch a demonstration of the lamp which is being perfected at this hospital by Dr. LoGrasso and his staff.

A complete programme for the three days of the meeting follows:

Friday, October 31

CHILDREN'S HOSPITAL

1. Summary of Results following Stoffel Operation for Spastic Paralysis. Cases shown to Illustrate Satisfactory and Unsatisfactory Results. Dr. Prescott LeBreton.
2. Industrial Back Injuries. Dr. F. N. Potts.
3. Bacteriological Studies of Lymphatic Glands in Selected Cases of Chronic Polyarthritis. Dr. Pio Blanco.
4. Rare Congenital Deformities. Dr. R. L. Cleary.

Friday, October 31

BUFFALO GENERAL HOSPITAL

1. Repair of the Crucial Ligaments of the Knee. Myositis Ossificans. Dr. A. L. Gartner.
2. Chronic Luxation of the Shoulder. Dr. W. W. Plummer.
3. Circulatory Disturbances of the Extremities. Dr. W. L. Machemer.
4. Thrombo Phlebitis of the Axillary Vein following Muscle Effort. Dr. Pio Blanco.
5. Two Cases of Congenital Lumbo-Sacral Deformity. Dr. W. W. Plummer.
6. Arthroplasty of the Knee. Dr. W. W. Plummer.
7. Arthroplasty of the Elbow. Dr. Prescott LeBreton.
8. Distemper in Dogs—Lantern Slides. Dr. Benjamin Roman.

Saturday, November 1

J. N. ADAM MEMORIAL HOSPITAL FOR TUBERCULOSIS, Perrysburg, New York

1. Inspection of the Hospital.
2. Demonstration of the Method and Results of Heliotherapy in Bone and Joint Tuberculosis.
3. Demonstration of "Lamp" Treatment in Bone and Joint Tuberculosis.

Dr. Horace LoGrasso and Staff.

By invitation of Professor Putti, the British Orthopaedic Association held its meeting at the Istituto Rizzoli in Bologna, Italy, on September 22, 1924.

The meeting was remarkable in many ways, and Professor Putti and Sir Robert Jones are to be congratulated in being able to bring over thirty members of the British Orthopaedic Association so far from home to attend a meeting in Italy. As would be expected with such a gathering entertained by Professor Putti, the meeting presented a

great deal of value and interest, and in spite of the fact that practically no set papers were read, the members were more than repaid for a journey to a distant country. A medical meeting conducted on the plan presented by Professor Putti gives to the attending members the opportunity of obtaining in full measure the most important feature of any medical meeting, namely, the opportunity of social and medical intercourse between those who are occupied in the same kind of work in widely separated places. Six nationalities were represented at this meeting, and each member felt that there had been given to him the opportunity of obtaining from the different members the special information which he most desired, and of comparing notes both in regard to diagnosis and treatment of those conditions in which he was particularly interested.

Two days were devoted to the work in the hospital and in the large appliance shop, which is unique and in which a degree of excellence of workmanship has been attained that is seldom seen. Professor Putti performed three operations for the Association, one of which was an arthroplasty of the knee, the technique of which was especially appreciated, and he also showed several results of arthroplasties, some of several years standing, and which showed excellent practical results. Following the two days of the meeting the members were taken to the Istituto Codivilla in Cortina to inspect the heliotherapy plant, which has also been developed to a high degree of efficiency, and were then motored through the Dolomites to Bolzano, at the end of which journey the members disbanded to their homes. The programme which was offered to the Association is given below.

The social part which was offered in the banquets, one on Monday night, presided over by Sir Robert Jones, and the second on Tuesday night, given by Professor Putti, needs no comment except the mention of the names of the presiding officers.

PROGRAMME OF THE MEETING

22 September

9.30 A.M. From Piazza Vittorio Emanuele two special trams will leave at 9.30 to take the Members up to the Istituto Rizzoli.
10.00 A.M. Welcome of the President of the Istituto Rizzoli.
10.30 A.M. V. PUTTI: Report on the treatment of congenital dislocation of the hip. (Lantern slides and demonstration of clinical cases.)
1.00 P.M. Luncheon at the Istituto Rizzoli offered to the Ladies and Members of the Congress by the Board of Trustees of the Istituto Rizzoli.
2.30 P.M. Visit to the Istituto Rizzoli.
4.30 P.M. Visit to the Shop of the Istituto Rizzoli.
8.00 P.M. Official dinner of the B. O. A. at the Hôtel Baglioni.

23 September

9.00 A.M. From Piazza Vittorio Emanuele two special trams will take the Members up to the Istituto Rizzoli.
9.30 A.M. Operations by DR. PUTTI and Staff. Demonstrations of clinical cases and results.
12.30 P.M. Trams to take the Members back to town.
2.30 P.M. The Members and Ladies will meet at the Hôtel Baglioni for going to the "Archiginnasio" (the old University). Short talk by DR. V. PUTTI.
3.30 P.M. Visit to the Monuments of the town.
7.30 P.M. Dinner at the Hôtel Stella d'Italia offered to the Members and Ladies by DR. V. PUTTI.

24 September

5.00 A.M. Breakfast at the Hôtels.
6.00 A.M. Train leaves for Mestre.
8.30 A.M. Arrival at Mestre and departure in motors for Belluno.
Lunch at Belluno and departure in motors for Cortina.
Arrival at Cortina about five o'clock.
Tea and dinner at the Hôtel.

25 September

9.00 A.M. In motors to the "Istituto Codivilla" and visit to the Istituto.
12 M. Lunch at Cortina.
2.00 P.M. In motors to Misurina via Passo Tre Croci.
6.00 P.M. Back to Cortina. Tea and dinner at the Hôtel.

26 September

8.00 A.M. In motors through the Dolomites road via Falzarego and Pordoi Passes to Bolzano.
1.00 P.M. Lunch at Lago di Carezza.
5.30 P.M. Arrival at Bolzano. Hotel Laurin and Bristol.

The Central States Clinical Orthopaedic Society has held a meeting this season in Cleveland, Elyria, and Cincinnati.

The meeting opened at Lakeside Hospital in Cleveland, Ohio, at 9 A.M., November 10th. A very interesting group of cases presenting the results following Stoffel's operation, with or without other orthopaedic measures, was presented, the results being most encouraging. Doctor Royle, of Australia, had recently been to this institution and had demonstrated the operation of sympathectomy. From the discussion and from the experience of those present, one would be led to believe that the operation is one which will give beneficial results in carefully selected cases, though the usual orthopaedic measures must be carried out. In the group of cases which caused considerable discussion were those of chronic osteomyelitis, in which sub-periosteal resection of the diseased bone had been performed. It was obvious that the results were very encouraging. A large drain ¾ inch in diameter was inserted in the upper angle of the wound and a drain ¼ inch in diameter into the lower angle. A moving picture was shown of a patient fifty years of age, with paralysis agitans of fifteen years' duration, in which a right lumbar sympathectomy had been performed with a most striking result, the patient being able to walk, run, and climb stairs without difficulty, whereas before the operation the picture showed him with a very marked spasticity and difficult locomotion, even though he used crutches. While the operation had been performed on the right side, the result was equally good in both legs, and this was explained as possibly due to the fact that there was crossed innervation from one set of sympathectics to the other. There were several interesting roentgenograms shown of bone tumors, one in which bone destruction resulted from radium without any evidence of apparent restoration. A very interesting Clinic on stabilization operations done upon flat feet and various deformities was given.

Luncheon was served at the Western Reserve Medical School.

At 1.15 Clinics were held at Mount Sinai Hospital. Several cases of arthrogryposis multiplex congenita were shown, in which there were congenital stiff joints, apparently a clinical entity. Multiple osteotomies had been performed with benefit. Fusion of the patella to the femur in cases of flail knee was demonstrated, with apparent excellent results, in one instance the patient falling and fracturing the femur four inches above the knee, the patellar tendon holding. An excellent modification of the Bradford frame used in conjunction with a cart was shown, the patient sitting on the well side, with the thigh flexed, while traction was made to the end of the frame in the usual manner. At this Institution 12% of all fractures received are compound. Of 155 compound fractures treated conservatively, there were no deaths, no non-unions, nor permanent cripples, though delayed union was not infrequent. X-ray treatment was advised in delayed union. Contracture deformity, illustrated in a case of Volkmann's ischemic paralysis, was treated with a cast split under the wrist joint, extension being produced by a special screw arrangement. Several Lorenz bifurcation operations were shown, with apparently satisfactory results. Here also an interesting group of cases of spastic paralysis in children was shown, following Stoffel's operation and orthopaedic measures, with apparently excellent results.

The Society left Cleveland at 4.30 P.M. en route to Elyria, Ohio, where a most interesting meeting was held at the Gates Hospital for Crippled and Deformed Children. The most common condition found in this Institution is chronic osteomyelitis, and a number of very interesting and some unusual cases were shown, as well as numerous other orthopaedic conditions, such as stabilization operation, congenital hips, etc.

A banquet was served at the Elyria Country Club, where Mr. Edgar F. Allen, founder of the Elyria Hospital and President of the International Society for Crippled Children, gave an excellent address dealing with the problems of the crippled child. A moving picture was shown demonstrating the method of carrying on the work of the Society through the Rotarians, it being the plan to organize all the States and Canada so as to give the crippled child an opportunity to obtain proper care and education. Mr. Allen explained that without the addition of a single hospital bed it was possible through education and legislation to care for the crippled children by what is known as the "Ohio Plan." Further information concerning this matter can be obtained from Mr. Allen, at Elyria, Ohio.

The following day the Society met at the Cincinnati General Hospital, where the Staff presented a most interesting program. A case of adolescent coxa-vara treated by the Whitman operation and cast was shown, six to eight months' fixation being advised. A young man with infectious arthritis with flexion deformity of the knees and hips was shown with a hip arthroplasty, the patient being improved and able to walk, although there was still flexion deformity of the knees and of one hip. An interesting discussion arose regarding the treatment of these cases. There were several bone tumors, and again the spastic paralysis demonstrated. Four or five hundred fractures are treated annually at this Institution, conservative measures being the preferred method. When ice tongs are applied in the region of the ankle they are placed through the malleoli in order to allow free ankle motion. Many patients were shown demonstrating excellent results of conservative measures in tuberculosis and of surgical measures in poliomyelitis. A method of measurement and recording deformities of the spine was demonstrated, and also the method of applying a plaster jacket in cases of scoliosis. The morning was concluded by a visit to the School for Crippled Children and heliotherapy ward. The afternoon session was held in the same Institution, where several interesting patients

with tuberculosis of the spine, who had been operated upon were shown; two patients with osteogenesis imperfecta, several bone tumors, syphilis of the spine, and fractures. The meeting was continued at the Medical College Building, University of Cincinnati, where demonstrations of the production of annular ligaments proved most interesting and instructive. Experiments on the effect of diet in the healing of ulcers have been carried out in this Institution with striking results, demonstrating the relations of vitamins to the pathologic process. A chart was shown and the measurements of the segments of the foot given, with special reference to hallux valgus.

The officers of the Society for 1925 are: Dr. F. J. Gaenslen, Milwaukee, President; Dr. Wallace Cole, St. Paul, Vice President; Dr. H. W. Meyerding, Rochester, Secretary and Treasurer.

A detailed programme of the meeting follows:

Cleveland, Ohio, November 10, 1924.

LAKESIDE HOSPITAL

9.00 A.M. DR. W. A. HOYT, Akron. Demonstration of cases.

9.20 A.M. DR. ELLIOTT C. BUTLER. Recent developments in heart surgery.

9.40 A.M. DOCTORS G. I. BAUMAN, R. E. STIFEL, L. M. STARIN, C. E. CAMPBELL.
Infantile paralysis. Spastic paralysis. Birth paralysis. Volkmann's paralysis. Paralysis of leg following childbirth. Congenital deformities: 1. Flat feet; 2. Club feet; 3. Anomalies of spine; 4. Dislocation of hip. Bowlegs—bone softening. Knock knees—bone softening. Genu recurvatum. Hallux valgus—Keller operation. Osteomyelitis—resection cases. Osteomyelitis—spinous process. Transverse process operation. Perthes' disease. Tuberculosis—knee resection. Torticollis.

11.00 A.M. Cases from Cleveland Clinic, DR. DICKSON and Associates.
Differential diagnosis of bone tumors with special reference to Ewing's tumor. X-ray films, DR. NICHOLS.
Deep X-ray therapy of bone tumors, presentation of cases, DR. PORTMANN.
Recklinghausen's disease, presentation of case, DR. NETHERTON.
Koehler-Perthes Syndrome, presentation of cases, DR. DUNCAN.
End results of stabilization for paralytic foot: Moving picture demonstration and presentation of cases, DR. DICKSON.

AFTERNOON SESSION, MT. SINAI HOSPITAL

1.15–1.30 P.M. DR. J. J. KURLANDER. Presentation of:
1. Case of Köhler's disease of the scaphoid.
2. Case of osteo-periosteal graft in Pott's disease.
3. Case of paralysis of the leg from carbon monoxide poisoning.
4. Paralysis of the leg (maternal during delivery).

1.30–2.45 P.M. DR. WALTER G. STERN.
1. Fatty deposits giving calcareous-like shadows in subdeltoid bursitis.
2. Arthrogryposis multiplex congenita. Presentation of three cases.
3. Patellapexy. Presentation of a case.
4. Modified gaspipe extension frame for treatment and correction of deformity in hip disease.

5. Conservative treatment of compound fractures. Presentation of cases.
6. Paraplegia in Pott's disease.
7. Drop phalangette.
8. Congenital genu recurvatum.
9. Volkmann's ischaemic contracture treated by wedge casts.
10. Brace treatment of Erb's palsy.
11. Epiphyseolysis. Presentation of case.
12. Fracture of osteoarthritic exostosis of the spine in patient doing heavy manual labor.
13. Kummel's disease of the spine. Presentation of case.
14. Heliotherapy in osteomyelitis.

2.45–3.00 P.M. Dr. Rudolph S. Reich.

1. Bifurcation operation for irreducible congenital hip dislocation. Presentation of three cases, including one case of traumatic "bifurcation operation" after fracture.
2. The extension treatment for fractures of both bones of the forearm.

3.00–3.15 P.M. Dr. Clarence H. Heyman.

1. Presentation of end results of the Stoffel operation.
2. Results of operative treatment of paralytic genu recurvatum.
3. Demonstration of radiograms of a case of diffuse endothelioma of the femur (Ewing's tumor).

3.15–3.30 P.M. Dr. E. A. Pohle.

1. X-ray therapy of delayed union of fractures with presentation of cases.

3.30–4.00 P.M. Dr. T. A. Willis, St. Lukes, St. Alexis, Charity Hospitals.

1. Anomalies of the last lumbar vertebra.
2. Some interesting failures. Presentation of cases.

Elyria, Ohio, November 10, 1924

Gates Hospital for Crippled and Deformed Children

Drs. W. H. Hull and Walter G. Stern

5.30–7.00 P.M.

1. Chronic osteomyelitis with special reference to heliotherapy treatment. Dr. Stern to open discussion and to lay down fundamental principles. Dr. Hull to present individual cases and X-rays.
2. Dr. Hull to discuss an unusual case of osteomyelitis with foreign body in the shaft of the femur. Bifurcation operation of head for extreme lordosis.
3. Dr. Stern. An unusual condition of natural formation of bony shelf in congenital dislocation of hips.
4. Dr. Stern. Paralysis of leg after Dénucé reduction of congenital dislocation of hip.
5. Dr. Hull. Sever operation for obstetrical paralysis.
6. Drs. Stern and Hull. Stabilizing operations of foot.

7 and 8. Drs. Stern and Hull. Unusual osteochondritis of ankle joint. Ostitis fibrosis cystica in a girl of fourteen.

9. Dr. Hull. A case of luetic dactylitis.
10. Dr. Stern. Sudden onset of paralysis in spinal cord tumor.
11. Dr. Stern. Some orthopaedic results of the Lorain disaster.

9.00 P.M. Showing of the Film of the International Society for Crippled Children, "State Aid for Crippled Children."

10.00 P.M. Address by Mr. Edgar F. Allen, founder of the Ohio and the International Societies for Crippled Children.

Tuesday, November 11, 1924, at Cincinnati, Ohio.

Cincinnati General Hospital

9.00 A.M. A. H. Freiberg: Adolescent coxa vara (slipped epiphysis).
Two cases of giant cell tumor of the femur.
Arthroplasty for bony ankylosis of the hip, without interposition of tissue.
Three cases of spastic paraplegia after obturator neurectomy.
Three cases of joint tuberculosis with multiple lesions, healed by heliotherapy.
Congenital equinovarus; result after forcible correction and tenotomy in a girl of 17.
Bone and fascial tuberculous abscess and secondary infection. Intravenous use of Mercurochrome.
Two cases of extensive polioparalysis; operative results.

10.00 A.M. George Heuer: A new method of treating surgical lesions of the lower end of the oesophagus; case demonstration.
Graeme Mitchell: Occult spine bifida associated with other deformities.
H. Higgins: Case of hydrocephalus.
John A. Caldwell: Treatment of fractures of the femur by balanced traction.
Treatment of fractured olecranon by direct fixation and splinting in flexion.
Treatment of fractures of tibia and fibula by direct bone traction.
H. Hoppe: Neurological case.

11.00 A.M. A. H. Freiberg: Measurement and record of lateral deviation of the spine.
Measurement and record of anteroposterior curve of spine.
Simple and inexpensive goniometer.
Demonstration of method of applying scoliosis jacket.

11.45 A.M. Visit to School for Crippled Children and Heliotherapy Ward.

2.00 P.M. Sidney Lange and Ralph Carothers: The demonstration of the fifth lumbar transverse process by roentgenography.
Robert Carothers: Spastic paralysis. Obturator neurectomy.
Results after Albee operation for spinal tuberculosis.
The after treatment of Pott's fracture.
R. B. Cofield: Three cases of osteogenesis imperfecta after operation.
Friedreich's ataxia.
Sarcoma of femur.
Un-united fracture of humerus.
Syphilitic spondylitis.

Bony bridging in tubercular spine.
Subastragaloid arthrodesis for traumatic arthritis.

4.00 P. M. At Medical College Building.
O. V. Batson and M. M. Zinninger: Experimental production of annular ligaments.

4.30 P.M. A. P. Matthews: Effect of diet on healing of ulcers.

5.00 P.M. J. W. McCammon: Measurements of the segments of the foot, with especial reference to hallux valgus.

A meeting of the Chicago Orthopedic Club was held on Friday evening, December 12, 1924, with the following programme:

Davis Method of Closed Reduction of Congenitally Dislocated Hip. Frank D. Dickson, M.D., Kansas City.

Laminectomy, Operative Technique. F. J. Gaenslen, M.D., Milwaukee.

Open Method of Treatment of Congenitally Dislocated Hip: Remarks on Cases Treated in Detroit by Dr. H. P. H. Galloway. Frederic C. Kidner, M.D., Detroit.

Brief Reports of the Post-Operative Findings of Patients with Spastic Paralysis Operated upon in Chicago by N. D. Royle, M.D., Sydney, Australia: "Sympathectomy." B. H. Moore, M.D., C. M. Jacobs, M.D., C. A. Parker, M.D., Philip Lewin, M.D., E. W. Ryerson, M.D.

The discussion was opened by Drs. George W. Hall, George de Tarnowsky, John Favill, M. S. Henderson (Rochester), Hugh T. Patrick, John Ridlon, and A. J. Carlson.

The Robert Jones Orthopaedic Club met in Baltimore on December 5 and 6, 1924.

The meeting on the first day was held at the Johns Hopkins Hospital, where the following demonstrations were held:

Arthroplasties. Dr. Baer.
Non-Spinal Psoas Abscess. Dr. Nachlas.
Sacro Iliac Strain. Dr. Lenhardt.
Spinal Cord Tumors. Dr. Dandy.
End Results of Bone Graft of Spine in Pott's Disease. Dr. Shands.
Age in Relation to Types of Bone Lesions. Dr. Baetjer.
Bone Tumors. Dr. Bloodgood.
End Results of Stoffel Operation in Spastic Paralysis. Dr. Clark.
End Results of Stabilizing Operations on Paralytic Feet. Dr. Kuhns.
Hamstring Spasm in Cases of Spinal Cord Lesion. Dr. Johnson.
Certain Phases of Intestinal Obstruction. Dr. Hughson.
Epidemiology and Serum Treatment of Acute Anterior Poliomyelitis. Dr. Amoss.
Demonstration of Cases. Dr. Leadbetter.
Dr. Halstead's Contributions to Treatment of Osteomyelitis. Dr. Rienhoff.
Fracture Clinic Results. Dr. Firor.
Osteomata of Lower End of the Tibia. Dr. Weinberg.
Diet and Bone Growth. Dr. McCollum.
Treatment of Epiphyseal Separation of Femoral Head. Dr. Bennett.

The meeting on the second day consisted of ward rounds and a clinical discussion of cases at the Children's Hospital School.

BOOK REVIEWS

RELATION OF MEDICINE TO INDUSTRY. Special Report Number Thirty, of the National Industrial Conference Board.

This pamphlet contains valuable papers which were presented at the Meeting of the National Industrial Conference Board in New York, on the occasion of the celebration of its tenth anniversary. In that meeting a large number of members and guests were gathered who were actively interested in the medical and surgical industrial problem. The pamphlet includes the addresses not only of the industrial surgeons, but also those of the superintendents and employers, in which papers the problem is discussed from different angles. These addresses include one by Magnus W. Alexander, Managing Director of the Board, who gave a brief but complete history of the origin and development of this Board, which has played an active rôle. Labor was represented by Samuel Gompers. The following papers were presented and discussed, and although the collection of these addresses is too long to warrant a review of the different subjects presented, they all merit careful attention.

Afternoon Session

Dr. Wm. H. Park, The American Public Health Association and Industrial Medicine.
Dr. Edward Livingston Hunt, The American Medical Association and Industrial Medicine.
Dr. L. A. Shouldy, Function of the Physician in Industry.
Mr. Samuel Gompers, Employees' Interest in Industrial Medicine.
Mr. C. R. Hook, Employers' Co-operation in Medical Work.
Dr. O. P. Geier, Monopolistic State Insurance and Industry.
Dr. Harlow Brooks, Inspection in Physical Diagnosis.

Evening Session

Dr. R. C. Williams, The United States Public Health Service and Industrial Medicine.
Mr. M. W. Alexander, The Conference Board of Physicians in Industry.
Dr. J. J. Moorhead, Traumatic Surgery—Its Development and Relation to Industry.
Mr. Howell Cheney, What Industry Requires of Medical Supervision.
Dr. W. Gilman Thompson, Industrial Medicine and Medical Education.

PRACTICAL SURGERY ILLUSTRATED. Victor Pauchet. Vols. I and II. Translated by F. R. B. Atkinson, M.D., C.M., (Edin. Univ.). With an Introduction by Sir Charles Gordon-Watson, C.M.G., F.R.C.S., Surgeon and Joint Lecturer in Surgery, St. Bartholemew's Hospital. London: Ernest Benn Limited, 1924.

This is a very abundantly illustrated series of operations taken from routine work, with sufficient text to explain the steps of the operation and the reasons for undertaking

this particular procedure. Several chapters are written by various other French surgeons who have become proficient in certain fields, and these are illustrated by the same artist.

These first two volumes of this very unique series of surgical books are extremely full of interesting points not generally practised in this country. The author shows his tremendous experience and individuality by concise text, getting at the important facts as he has found them in his practice without too much argument. The illustrations are beautifully done by S. Dupret. So numerous are the drawings that the operation can be followed in every detail. Every practising surgeon will get new ideas from this work.

NORMAL BONES AND JOINTS. Isidore Cohn, M.D., F.A.C.S. With a Foreword by Rudolph Matas, M.D. New York: Paul B. Hoeber, Inc., 1924.

Normal Bones and Joints, roentgenographically considered, by Isidore Cohn, M.D., F.A.C.S., with a foreword by Rudolph Matas, M.D., has recently been published by Paul B. Hoeber, Inc. This is Volume IV of the Annals of Roentgenology, a series of monographic atlases edited by James T. Case, M.D.

The purpose of the work is to present a study of normal joints from a roentgenologic standpoint as a standard for comparison. The book consists of plates and illustrations and a review of literature, conclusions based on the study of normal joints, descriptive findings of individual roentgenograms of particular joints at various ages and the importance to be attached to such a study from the surgical standpoint and suggestions of its value to others.

The joints considered are the normal shoulder, elbow, wrist, hip, knee and ankle.

This book fills the need which any one doing orthopaedic work has felt for a long time. It gives to the profession a standard with which the many changes so commonly met in bone and joint changes can be compared.

Current Literature

TRAUMATIC CONDITIONS

LOW BACK STRAIN, WITH PARTICULAR REFERENCE TO INDUSTRIAL ACCIDENTS. E. G. Brackett. *Jour. A. M. A.*, October 4, 1924, p. 1068.

This subject is discussed, first, in relation to the character of the violence at the time of injury, and, second, in relation to the condition existing in the spine at the time of injury.

The character of the violence may be either muscular exertion, especially with the spine in a vulnerable position, or external mechanical violence. The condition of the spine may be normal, it may be affected by osteoarthritis or other disease, or it may have a structural anomaly or deformity.

An exact history as to the character of the violence, together with a careful study of the condition of the spine at the time of injury, will aid in determining both present and future disability. Arthritis of the spine may exist for a long time without marked symptoms, until some trauma, even a mild one, produces a disability, often severe and lasting. Structural anomalies of the fifth lumbar vertebra are frequent predisposing factors. The author thinks it unfair to both employers and employees to place workmen with diseased or otherwise defective spines on jobs which subject them to severe strain and the danger of prolonged disability. These men should be discovered by routine examination and put on less dangerous jobs.—*R. W. Billington, M.D., Nashville, Tenn.*

FRACTURES OF THE HEAD OF THE RADIUS. Hans Storck. *Arch. f. Orthop. und Unfall-Chir.*, 23, 1, 1924, p. 131.

Fractures of the radial head form 83% of all fractures, and in about half of all cases there is a complete separation of the head or of a part of it from the shaft. They are frequently overlooked and receive inadequate treatment; the consequence is marked loss of motion in the elbow joint. The classical symptoms of fracture are but rarely elicited, but the loss of rotation of the forearm is a characteristic symptom. The exact diagnosis is made only from the radiograph with the elbow in anteroposterior and lateral positions and by comparison with the picture of the unaffected elbow. The etiology is, in most cases, indirect trauma from a fall upon the pronated hand, with a slightly bent elbow. Whenever there is proof of complete separation of the head or the presence of a fragment thereof, the removal of the loose piece is indicated. Of prime importance is the early motion of the elbow. Three days after the operation motion in all directions should be instituted. The prognosis with such procedure is very favorable.—*A. Gottlieb, M.D., Los Angeles, Calif.*

DIRECT LEVERAGE IN THE REDUCTION OF CERTAIN FRACTURES. James E. M. Thomson. *Surgery, Gynecology and Obstetrics*, September, 1924, p. 356.

Dr. Thomson has revived an old method of reducing fractures devised fifty years ago by Mr. Thomas of Liverpool. He refers only to fractures of long bones near the middle, where ordinary manipulation has not succeeded in aligning the fragments. A small incision is made over the fracture, and one end of an S-shaped lever is inserted between the fragments, which are then pried and eased into position. Sometimes the lever is left *in situ*, and a gypsum splint is applied which includes the lever, the outer end of which is sawed off to prevent striking it against objects. This could very well be a useful procedure in many cases of obstinate reduction. Four cases are reported.—*H. A. Pingree, M.D., Portland, Me.*

THE PROBLEM OF THE INDUSTRIAL LAME BACK. Robert B. Osgood and Lawrie B. Morrison. *Boston Medical and Surgical Journal*, August 28, 1924, p. 381.

The article discusses at some length the matters of malingering and real honesty in afflictions following industrial injuries. A strong plea is made for careful, thorough, and complete physical examinations. Then follows an outline in schematic form which covers nearly all conditions found in the spine under present-day knowledge. This scheme, under many headings and sub-headings, briefly states the methods of examination, diagnosis, and treatment of the several conditions considered. It is most comprehensive and carefully prepared. The following are the main points stressed: Careful histories and routine examinations; pre-employment examination of all workers; more extensive knowledge of anatomy than we now possess; roentgenograms the most valuable single aid to diagnosis; ability to estimate and evaluate psychic factors. Twenty half-tone skiagrams illustrate the paper.—*H. A. Pingree, M.D., Portland, Me.*

BONE AND JOINT TUBERCULOSIS

TUBERCULOSIS OF THE KNEE: IMPORTANCE OF DIAGNOSIS. Nathaniel Allison. *Jour. A. M. A.*, September 6, 1924, p. 750.

Tuberculosis of the knee joint is a diagnosis difficult to establish, especially in the early stages of the disease. The diagnostic methods commonly in use are dependent on evidence mostly circumstantial in nature. Animal inoculation and pathologic examinations of tissues from the joint are the only accurate means of diagnosis. In cases in which the circumstantial evidence points definitely to tuberculosis, exploratory arthrotomy should be performed to obtain tissue for microscopic study and animal inoculation.—*R. W. Billington, M.D., Nashville, Tenn.*

A SPINAL COLUMN SPECIMEN NINE YEARS AFTER AN ALBEE OPERATION. *Pusch. Zeitsch. f. orthop. Chir.*, Vol. 45, 1-2, 1924, pp. 369-371.

A demonstration of a specimen obtained at autopsy from a boy, fourteen years of age, who had been operated upon nine years previously for a dorsal Pott's disease, revealed the following interesting facts: The transplant had reduced in size from 7 cm. to 4.5 cm. It bridged at the time of operation six dorsal spines; at autopsy, only three spines. It proves that the distance between two spines remains unchanged in the nine years

of the child's growth; in other words, the transplant has hindered the growth of the region which has received it. Unfortunately it could not be determined how much of this interference of growth had occurred in the bodies of the respective vertebrae because they were totally destroyed by the tuberculous process. This is contrary to the opinion of Albee that the transplant continues to grow. The specimen proves that it not only does not, but even interferes with the growth of the site of the transplant. In width the transplant had grown considerably. This proves the importance of its function in guarding against collapse of the respective region.—*A. Gottlieb, M.D., Los Angeles, Calif.*

THE OPERATIVE SPLINTING OF TUB..ICULOUS SPINES WITH CELLULOID BARS. F. Lange. *Zeit. f. orthop. Chir.* Vol. 45, 3-4 1924, pp. 492-503.

The following sentences comprise the author's views of the present-day modes of treatment of Pott's disease:

1. For the acute, painful stage, the plaster bed still holds the first place as an efficient, simple, and cheap appliance.

2. The customary spinal braces and corsets, which find application after the pain has disappeared, have not fulfilled the expectations placed in them. They are not in position to prevent the formation of the kyphos in the majority of juvenile and growing patients. Prolonged recumbency in a plaster bed, followed by a corset which extends to the occiput, may be efficient, but is prohibitive because of length of time and expense of care.

3. It is therefore essential to resort to a method of operative splinting of the spine.

4. Albee's modification of Lange's operation, which was first performed in 1902, has the advantage that the bone transplant heals in quicker than the tinned steel wire which was recommended by Lange. Its disadvantages, however, consist in the weakness and shortness of the bone transplant for many cases, in the lack of adaptability of the transplant to individual forms of the curve, and, most important of all, that the transplant is unable to withstand the strain of weight-bearing and flexion and breaks at the point of greatest strain, forming a pseudoarthrosis, verified by Biesalski, Mueller, and the author.

5. The advantage of solid union of the bone transplant, on the one hand, and the perfect adaptability of the steel bars, on the other, are combined in the method which Lange adopted in 1920 by the use of celluloid bars for implantation into the spine. Celluloid is the foreign substance which heals in the easiest in the human tissues and which causes the least irritation when implanted.

The primary fixation of the diseased spine with celluloid bars is the most reliable of all methods advocated up to the present time: the fixation is secure, fully adapted to the form of the spine, and influences favorably the pain and healing of the diseased process.

6. With proper technique the celluloid-bar implantation does not expose the patient to any notable danger.

7. In mild and medium sized kyphosis the celluloid splinting guards against an increase of the gibbosity. Whether a forward sinking of the supra-kyphotic region in a dorsal gibbus can be prevented by means of celluloid-bar implantation, has yet to be proven. Only four years have passed since this method was adopted by the author; hence the time is too short to present conclusive evidence in its behalf.—*A. Gottlieb, M.D., Los Angeles, Calif.*

CONGENITAL ABNORMALITIES

FAILURES AND DISAPPOINTMENTS IN THE TREATMENT OF CONGENITAL CLUB FOOT. M. Van Neck. *Archives Franco-Belges de Chirurgie*, 1924, 27, 247.

Nine cases of congenital club foot in which treatment was only partially successful are analyzed. Among the causes of trouble are: 1. Development of a painful exostosis on the os calcis; 2. Separation or injury to the lower epiphysis of the tibia, with resulting deformity or shortening; 3. Internal rotation of the ankle; 4. Fracture of the leg with deformity; 5. Irreducibility of the astragalus; 6. Limitation of the ankle or tarsal joints; 7. Marked over-correction with severe flat foot deformity; 8. Phelp's operation; and 9. Sloughing of the skin and tendons. Even in the new-born it is occasionally impossible to reduce the astragalus, and in these cases the author recommends astragalectomy.—*J. A. Key, M.D., St. Louis, Mo.*

FIVE CASES OF VERTEBRAL MALFORMATION, SO-CALLED CONGENITAL ELEVATION OF THE SCAPULA. Maffei. *Archives Franco-Belges de Chirurgie*, 1924, 27, 230.

The author states that he has never seen a case of congenital elevation of the scapula which was not accompanied by a malformation of the bodies of one or more vertebrae. He believes that the abnormal position of the scapula is due to the malformation of the vertebrae. Five cases are reported. The treatment is not operative, but consists of exercises.—*J. A. Key, M.D., St. Louis, Mo.*

HIP JOINT LUXATION AND OSTEOCHONDRITIS. Hans Spitzy. *Ztchr. f. orth. Chir.*, Bd. 45, H. 3-4, 1924, p. 576.

In treating a congenital dislocation of the hip the author uses either inward rotation after the method of Hoffa, or outward rotation (Lorenz), depending upon which is more suitable for reduction and retention of the individual case. A review of the end results of treated as well as non-treated cases showed many poor results due to changes in the acetabulum and in the head of the femur. This, the author believes, is due to the presence of osteochondritis juvenilis. He believes that the trauma produced during the reduction of the hip has little to do with the osteochondritis and the deformity, for the typical changes may be seen in a non-reduced hip, or even in the opposite non-dislocated hip.

The X-ray findings seem to show that the final deformity of the head and acetabulum is the result of an osteochondritis. Areas of decreased density are seen near the epiphyseal line and the head becomes flattened. With overload, the neck bends and a coxa vara results. Clinically, the patients tire easily and show limitation of abduction.

As to therapy, the author agrees that unnecessary trauma should be avoided. Cases should remain under observation for several years after reduction of the dislocation. It may be advisable to avoid weight-bearing for a time, although the deformity frequently proceeds in spite of every method of treatment.—*E. D. Hauser, M.D., Rochester, Minn.*

PARALYTIC CONDITIONS

A Pathologic-Anatomic Contribution to the Knowledge of Obstetrical Paralysis. Valentin. *Ztschr. f. orth. Chir.*, Bd. 45, H. 1-2, 1924, p. 337.

On the basis of a study of the literature and a thorough investigation of the anatomy and pathology of a case, the author concludes the primary lesion in birth palsy is due to nerve injury. The lesion is found in the periphery at the nerve root, or nerve trunk, while in severe cases the surrounding tissue is also involved. The author's case was bilateral and typical, yet it is the only instance where the cord has been studied and it revealed definite pathology (hemorrhage, degeneration, and scar formation). In most cases the author concludes that the time of occurrence is intra-partum. In view of concomitant deformities, an intra-uterine origin must also be assumed. No one theory can satisfactorily explain all the phenomena of birth palsy.—*E. D. Hauser, M.D., Rochester, Minn.*

Pes Cavus, Due to Paralysis of the Extensor Muscles, Dorsal Flexors, of the Feet. Thomas M. Foley. *Southern Medical Journal*, October, 1924, p. 798.

This article is a brief report of a case of paralytic pes cavus corrected by a resection of a cuneiform portion of the dorsum of the tarsus, a method long since employed. This is inferior to the method which employs arthrodesis of mid-tarsal joints and separation of plantar attachments to the os calcis, and the foot put up in plaster in extreme dorsal flexion.—*William Jackson Merrill, M.D., Philadelphia. Pa.*

BONE AND JOINT OPERATIONS

Reconstructive Surgery of the Hand. Sterling Bunnell. *Surgery, Gynecology and Obstetrics*, September, 1924, p. 259.

The title of this paper covers an immense and important field. The paper is so detailed and technical that an abstract to do it justice is impossible of accomplishment. One must see the operative and mechanical details of treatment in order to fully appreciate and understand it. The paper is illustrated by eighty-four excellent half-tones, each supplied with a comprehensive legend. A faint idea of the work necessary for results may be obtained from a close study of the pictures and legends. The text of the article, though written carefully, is difficult of interpretation, and, of necessity, for the most part hard to visualize. The following points stand out:

Use of metal splints which may be boiled.

The employment of zig-zag or transverse incisions for the relief of scar-tissue tension.

Steady, continuous pressure for the movement of joints, and in one direction at a time with splints.

The tubular skin-graft.

There has been a rather remarkable return of motion, muscle control, and sensation after the author's tendon, nerve, and skin grafting. As many as six inches of nerve tissue have been inserted with satisfactory conduction of impulse after a time.

The paper and illustrations show that Dr. Bunnell is doing excellent work, and it is difficult for all but a few outside of orthopaedic ranks to realize the infinite care and endless patience which is absolutely necessary in this particular line of surgery.—*H. A. Pingree, M.D., Portland, Me.*

MOBILIZATION OF JOINTS WITH BONY ANKYLOSIS. W. C. Campbell. *Jour. A. M. A.*, September 27, 1924, p. 976.

Cases must be carefully selected for operation. Favorable types of ankylosis are: (1) traumatic, and (2) ankylosis due to acute infectious arthritis due to staphlacoccus, streptococcus, pneumococcus, gonococcus, etc. Contraindication and conditions unfavorable to successful results are: (1) tuberculosis; (2) destructive osteitis in childhood; (3) extensive scars with skin adherent to bones; (4) long duration with extreme muscle atrophy; (5) extensive eburnation of bone near the joint; (6) active or recent acute infection; (7) osteoporosis; (8) childhood, as a rule.

Free flaps of fascia lata are preferred as the interposed tissue. Results have been greatly improved by a simplified technique without trying to accurately reproduce the lines of the normal joint, as in the knee joint, one large condyle is formed on the femur, fitting into one large shallow depression on the top of the tibia.

Conclusions in this paper are based on 110 arthroplasties: 14 elbows, 6 jaws, 23 hips, 59 knees, 2 ankles, 3 wrists, 1 phalangeal and 2 metatarso-phalangeal joints. Satisfactory results in the four most favorable joints were obtained by the improved technique in approximately the following percentage of cases: temporomaxillary, 90 per cent; elbow, 90 per cent; hip, 60 per cent; knee, 75 per cent.

Careful and thorough after-treatment is emphasized, and details of this are discussed.—*R. W. Billington, M.D., Nashville, Tenn.*

THE TREATMENT OF PERTHES' DISEASE OF THE HIP JOINT. G. Drehman. *Zeitsch. f. orthop. Chir.*, Vol. 45, 3-4, 1924, p. 431.

The experience obtained from old congenital hip dislocations that the replaced head of the femur remodels, in course of time, under the influence of the acetabulum, the author has utilized in the treatment of the condition in question. The flattened and ridged femoral head ought to reshape when replaced into the acetabulum. This is only possible when the replacement is undertaken in the early stage of the disease. Whenever the deformity is far advanced and the disease has existed months and years, the outlook is very much less favorable. The attempt should be made to bring the outwardly replaced head of the femur under the influence of the acetabulum. This can only be attained by forcible manipulations and complete abduction of the leg, under general anaesthesia. In the position of abduction, the leg is immobilized and the patient is allowed to bear weight. The spica is worn three months and then substituted by an abduction plaster spica or brace.

Operative interference should not be attempted in the early stage of the disease. Only after complete healing of the process and cessation of growth may a smoothing of the head or other operative measures be undertaken.—*A. Gottlieb, M.D., Los Angeles, Calif.*

AGAIN, THE OPERATION FOR HALLUX VALGUS. A. H. Freiberg. *Jour. A. M. A.*, September 20, 1924, p. 908.

The author prefers a modified Hueter operation. The following requirements are mentioned as essential to successful results: (1) A plastic flap of capsule, with base forward, is made for the purpose of maintaining adduction of the great toe; (2) After removal of the bony protuberance on the mesial aspect, the head of the metatarsal must

be thoroughly exposed; (3) After removal of the head, the end of the metatarsal must be made rounded and smooth; (4) All particles of bone should be removed; (5) The tendon of the extensor hallucis longus is completely divided; (6) The capsule flap is overlapped and sutured with silk so as to maintain correction of valgus. No flap is interposed between the bones; (7) A splint is applied to maintain position for ten days; (8) Then movements are begun to cultivate amplitude and power in flexion of the toe, which is very important.—*R. W. Billington, M.D., Nashville, Tenn.*

MISCELLANEOUS

SPONDYLITIS FOLLOWING CEREBROSPINAL MENINGITIS. R. W. Billington. *Jour. A.M.A.*, August 30, 1924, p. 683.

This paper is based on a study of thirty-five patients, mostly ex-service men, who complained of more or less low back pain and disability, dating from attacks of acute meningitis two to fifteen years previous to examination. The ages were from twenty-two to thirty-five years, except one child, aged twelve. In fourteen cases there were definite signs of spondylitis, including positive roentgenograms, and in twelve of these the pathologic changes were limited to the lower (third to fifth) lumbar region. These changes were hypertrophic in all twelve, in eight of whom there was also partial or complete destruction of an intervertebral disc in the same region. In two patients the pathologic changes were more general. Five others had all the clinical signs of lumbar spondylitis but the roentgenograms were either negative or of doubtful significance. The remaining sixteen cases had few or no objective signs of spondylitis and probably included psychoneuroses, malingerers, and perhaps some who may have had a mild spondylitis or meningeal adhesions causing the symptoms.

Since the meningococcus is known to have produced a low grade arthritis in joints of the extremities, the author believes that at least some of these cases are probably meningococcic arthritis of the spine. Since twelve of the fourteen cases with demonstrable pathology showed the changes limited to the lower lumbar region, it appears that the spinal punctures may have been an important causative factor, due to the fact that the needle point may easily prick the posterior surface of the vertebral bodies or discs after passing through the infected tissues within the canal, an ideal means of inoculating these structures.—*R. W. Billington, M.D., Nashville, Tenn.*

THROMBOANGIITIS OBLITERANS. Benjamine Jablons. *Medical Journal and Record*, September 17, 1924, p. 270.

Jablons enumerates extensively the terms used to describe this syndrome and the reasons therefor.

The etiology and pathology described by many researchers are tabulated extensively. The many theories as to causation, chemical, bacterial, and neuropathic, are given in detail. Promise is made of discussion of treatment, but it does not appear in this portion of the paper. The etiology and pathology are guides to treatment. The value of Jablons' paper would be enhanced if he had stated concisely from his own experience which cause of this condition is most likely.—*William Jackson Merrill, M.D., Philadelphia, Pa.*

CONSIDERATION OF FAMILIAL DISEASES OF LOCOMOTION. Alfred Gordon. *Medical Journal and Record*, September 17, 1924, p. 257.

This is a pertinent résumé of familial diseases and points definitely to the diseases that should not be included in this group of disorders. Some of the manifestations which characterize these diseases are discussed.

This article is too rich in neurologic data to be abridged in a few lines. Gordon states that these disorders arise in the germ plasm from an originally morbid taint. The statement that these diseases are not due to disturbance from without, but rather to developmental perversion, should be followed by a definition of the influence of bacterial and bactero-chemical conditions; also, whetheror not such "latent morbid taint" in the germ plasm is due to ancestral disease and not to degeneracy of purely physiologic source.

Tissue cells in the first cycle of uterine life—the embryonal—may have a susceptibility to mechanical and chemical influences that is not yet understood. In the second or foetal cycle the behavior of the cells to mechanical and chemical conditions is quite the same as it is postnatally.—*William Jackson Merrill, M.D., Philadelphia, Pa.*

EPIPHYSITIS OF GROWTH, ESPECIALLY THE PAINFUL EPIPHYSITIS OF THE SPINE IN ADOLESCENTS. E. Sorrel and A. Delhaye. *Presse Médicale*, 1924, page 737.

During the past four and one-half years at Berck the authors have received twenty-five cases of this condition. Usually the patients arrived with a diagnosis of Pott's disease. Three cases are reported in detail as follows:

The clinical picture is a child of eleven to fifteen years of age; the patient usually complains of pain in the lower dorsal or lumbar region, especially after exercise. There is no fever and the general health is good. A very slight kyphos may be noted. On physical examination there is always some tenderness over the affected vertebrae. (Usually the lower dorsal.) There may be some limitation of motion in this region and the spinous processes may be slightly prominent. The knee jerk may be exaggerated, but clonus never develops.

A roentgenogram usually shows a squaring of the vertebral bodies, with the appearance of ossification in the secondary superior and inferior accessory epiphyses of the bodies. These centers normally appear about the eighteenth year and their precocious appearance at twelve to thirteen years is almost pathognomonic of epiphysitis of growth.

The differential diagnosis from early Pott's disease is not possible. The clinical course makes the diagnosis. These cases are quickly relieved of pain by recumbency, but should wear a celluloid jacket for some months to prevent deformity.—*J. A. Key, M.D., St. Louis, Mo.*

OSTEOCHONDRITIS OF THE PUBIS. M. Van Neck. *Archives Franco-Belges de Chirurgie*, 1924, 27, 230.

Two children, eight and eleven years old, each with painful swelling of the ascending ramus of the right pubic bone, were operated upon by the author. In the first case the bone was softened. In the other case a definite osteo-cartilaginous tumor was removed. The pathologic diagnosis in both cases was osteochondritis. Healing was uneventful in both cases. The author believes that these cases present an unusual localization of the condition which in the hip gives rise to Legg's disease and in the tarsal scaphoid to Köhler's disease.—*J. A. Key, M.D., St. Louis, Mo.*